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FIG.1A
PRIOR ART

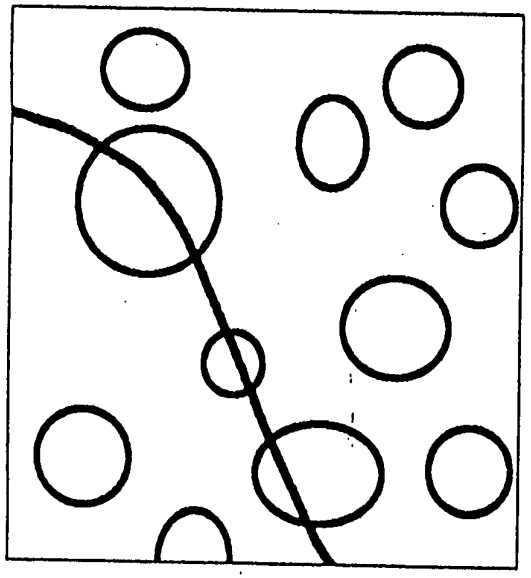


FIG.1B
PRIOR ART

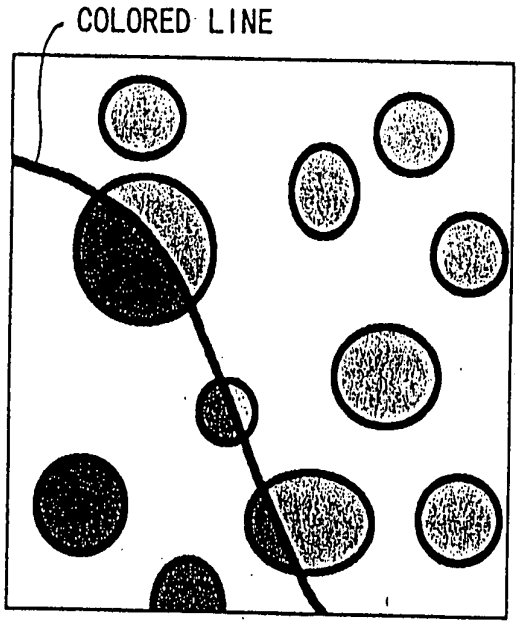
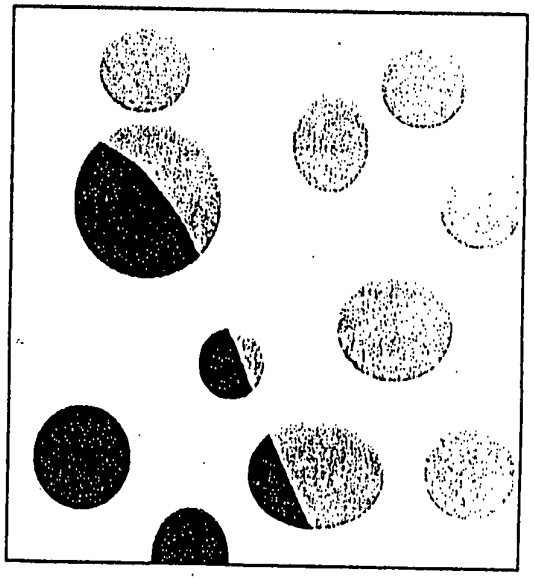


FIG.1C
PRIOR ART



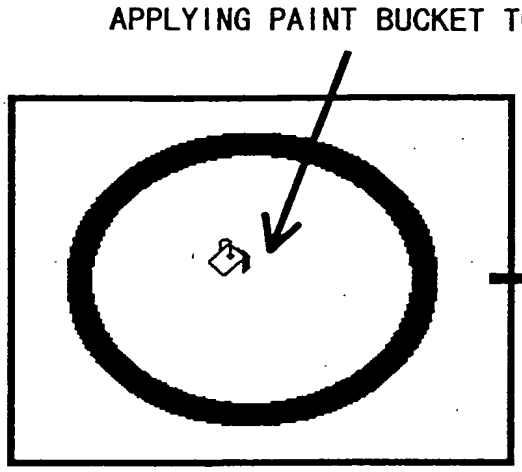


FIG.2A PRIOR ART

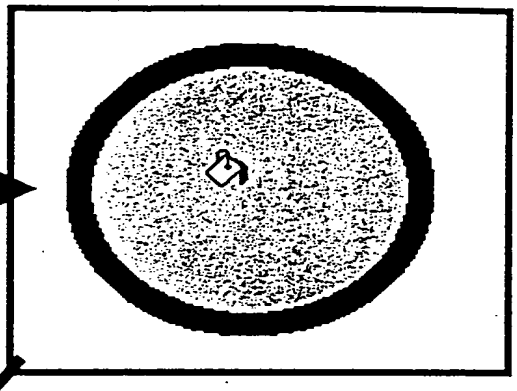


FIG.2B PRIOR ART

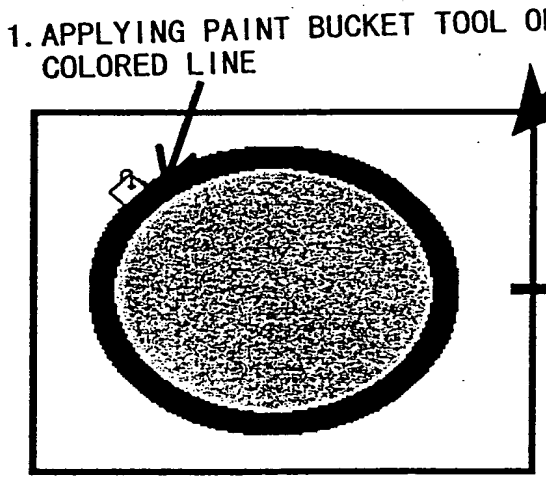


FIG.2C PRIOR ART

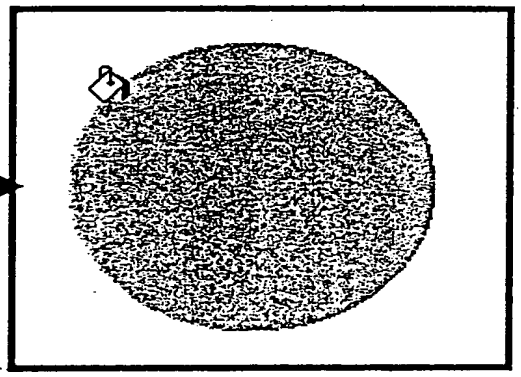


FIG.2D PRIOR ART

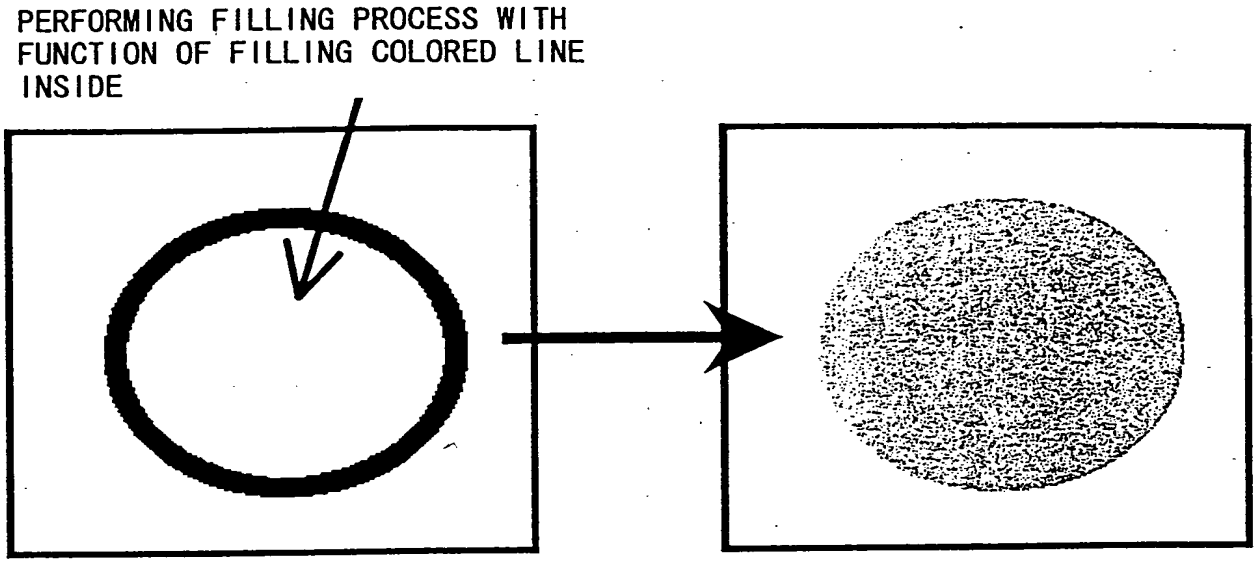


FIG.3A
PRIOR ART

FIG.3B
PRIOR ART

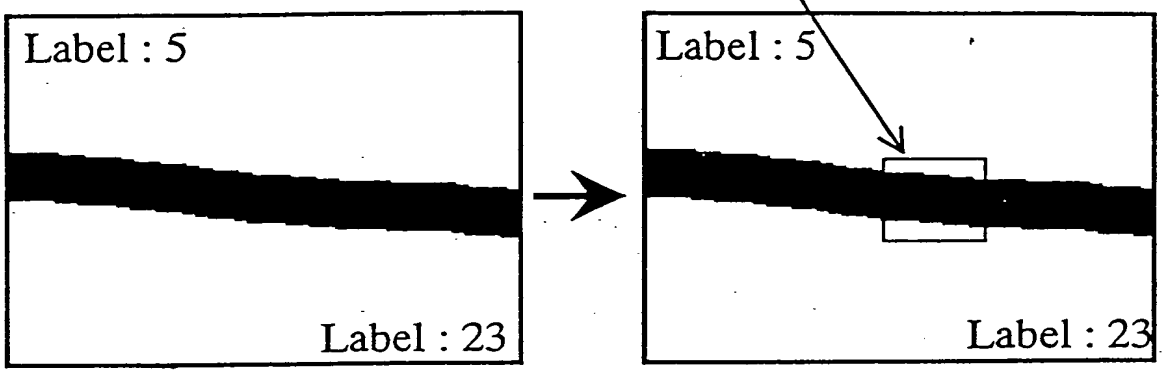


FIG.4A
PRIOR ART

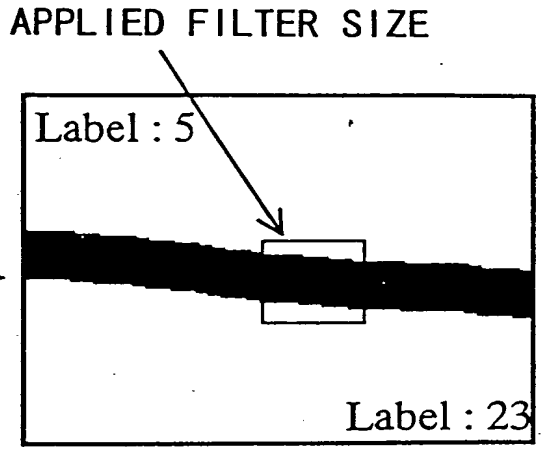


FIG.4B
PRIOR ART

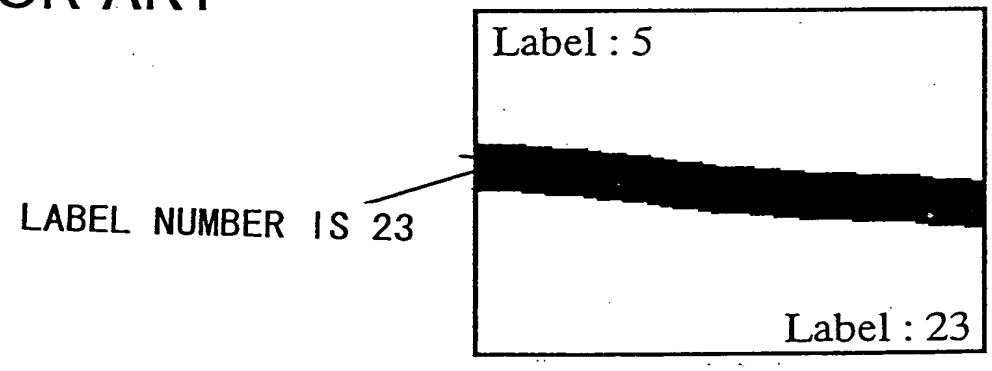


FIG.4C
PRIOR ART

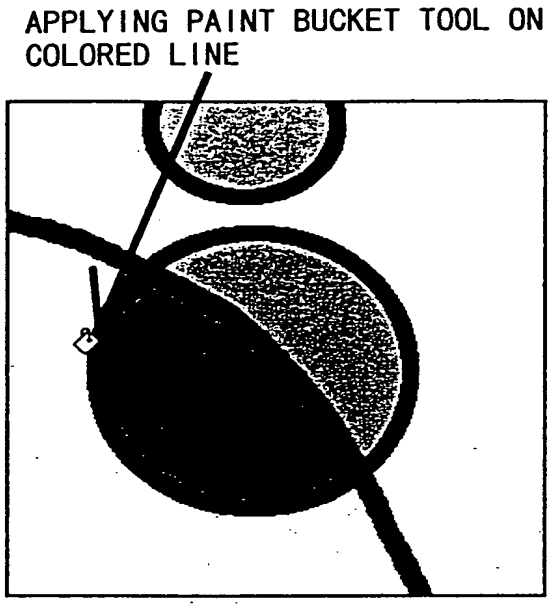


FIG.5A
PRIOR ART

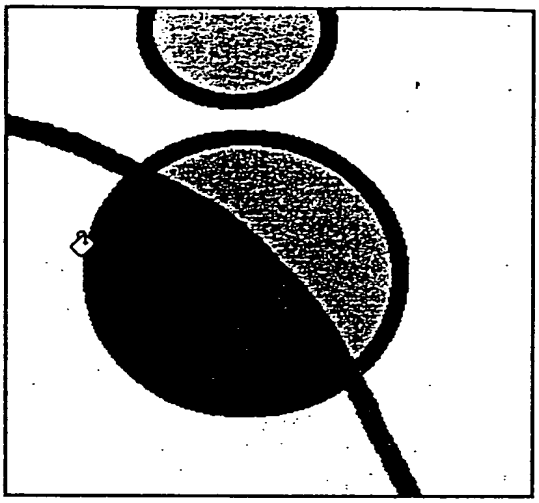


FIG.5B
PRIOR ART

1. SPECIFY REGION FOR APPLYING PAINT BUCKET TOOL

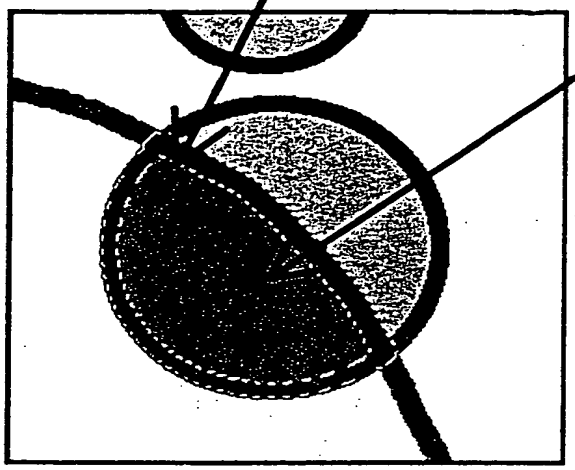


FIG.6A
PRIOR ART

2. APPLY PAINT BUCKET TOOL WITHIN THE REGION

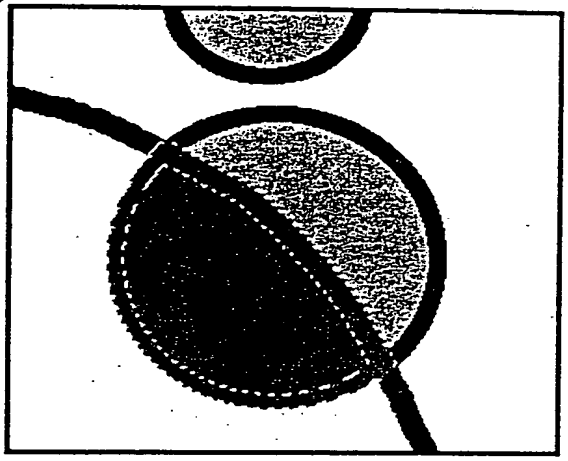
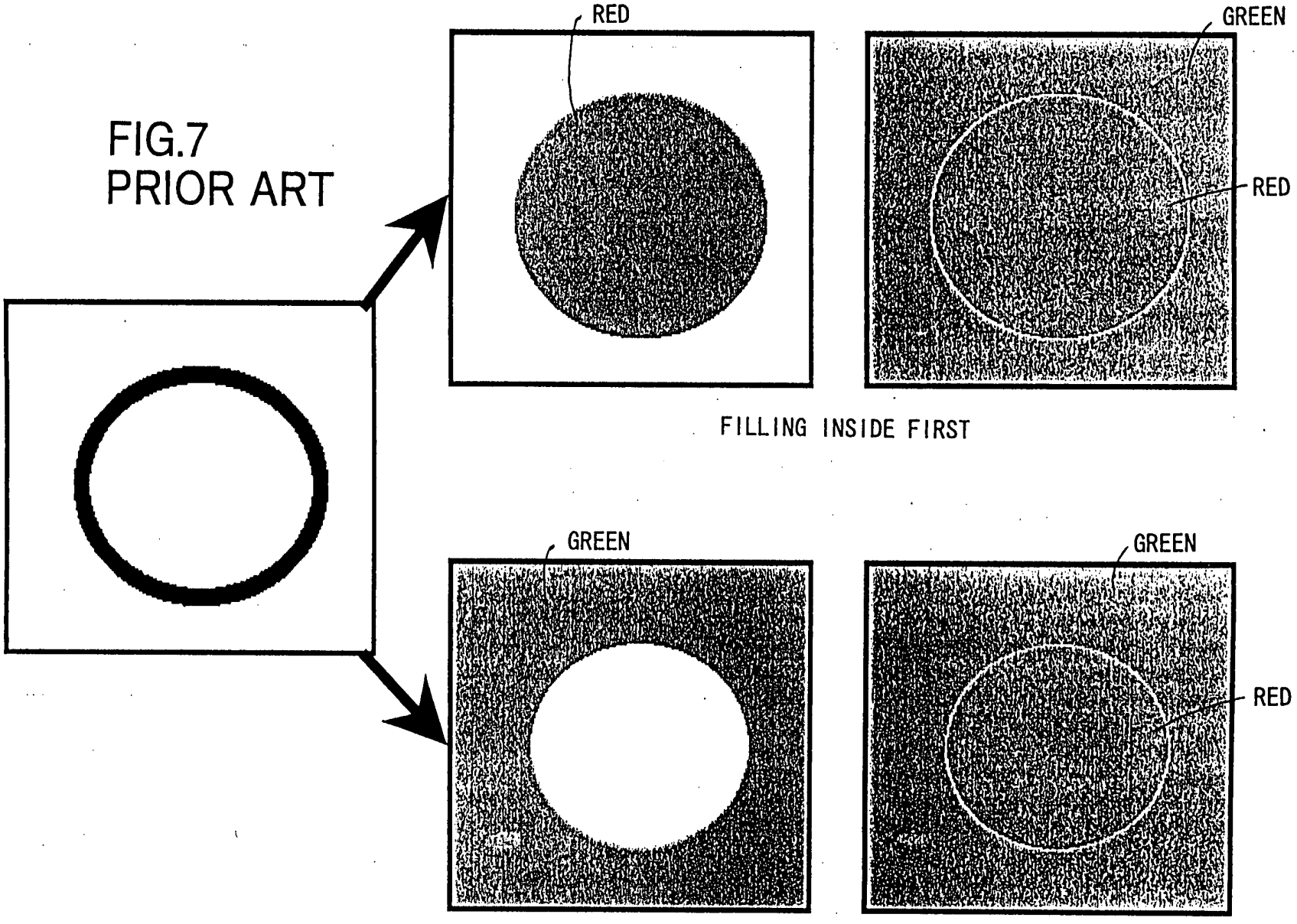


FIG.6B
PRIOR ART

FIG.7
PRIOR ART



WHEN USING FILLING TOOL WITH
FUNCTION OF FILLING COLORED LINE

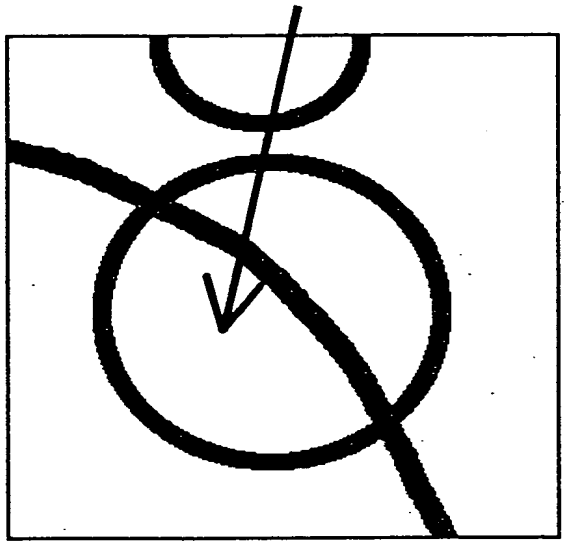


FIG.8A
PRIOR ART

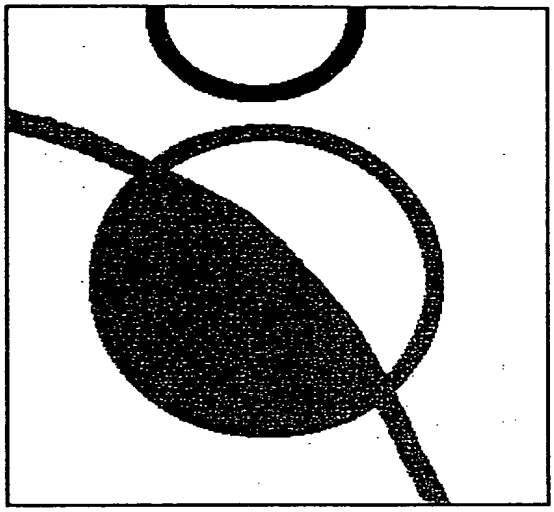


FIG.8B
PRIOR ART

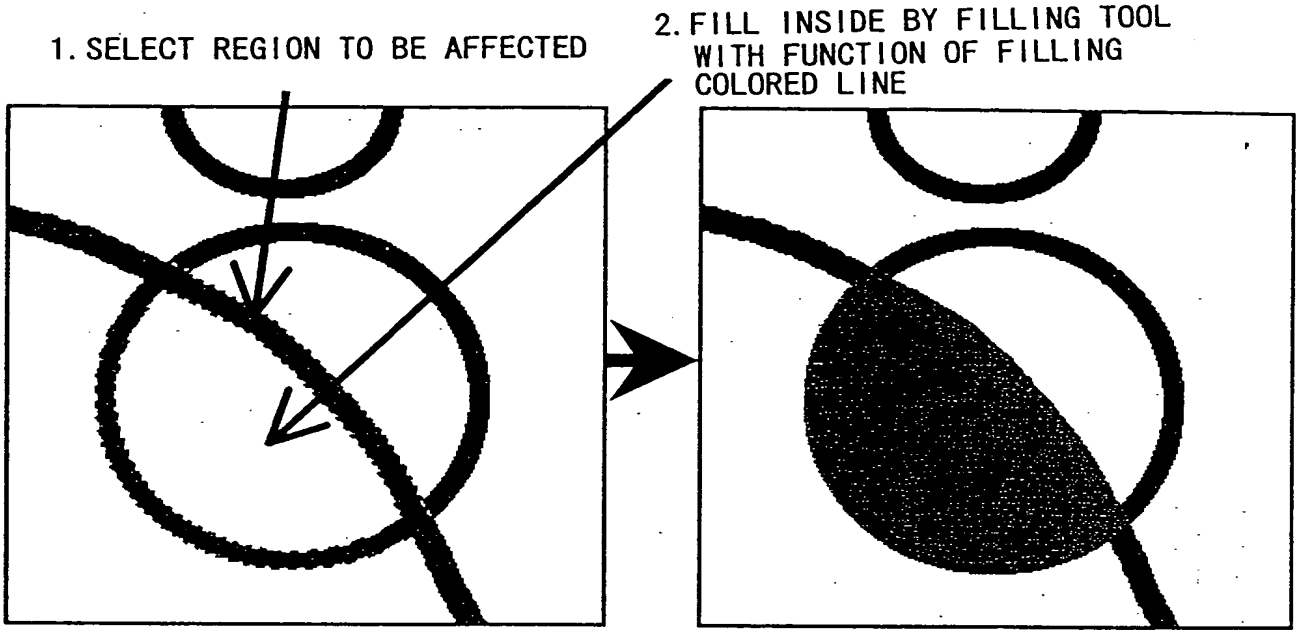


FIG.9A
PRIOR ART

FIG.9B
PRIOR ART

LABEL OF THIS COLORED LINE BECOMES 23.
HOWEVER, IT IS NOT KNOWN WHICH NUMBER 5
OR 23 IS ASSIGNED TO DARKER COLOR
AT THIS TIME.

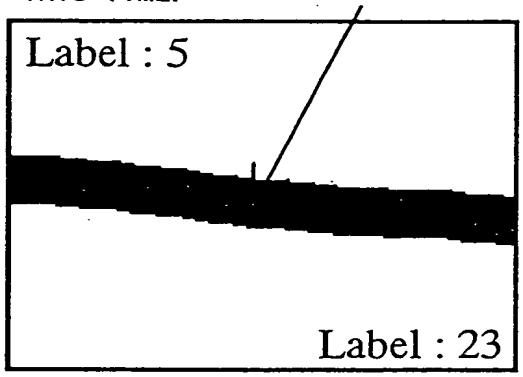


FIG.10A
PRIOR ART

IF FILTER SIZE IS SMALL,
THE COLOR OF THE LINE IS DEVIDED.

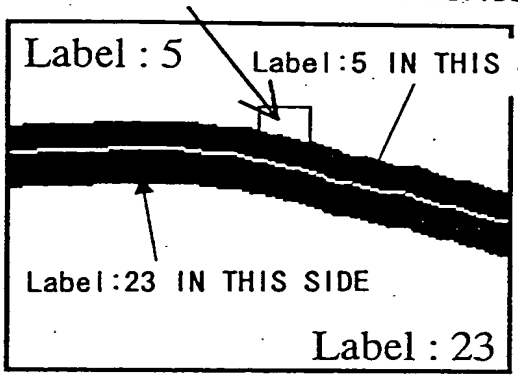


FIG.10B
PRIOR ART

IF FILTER SIZE IS FURTHER SMALLER,
THE PART OF THE COLORED LINE REMAINS.

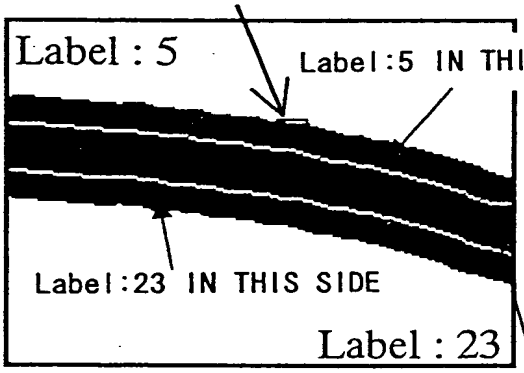


FIG.10C
PRIOR ART

IF FILTER SIZE IS LARGE, LABEL OF
UNRELATED COLSED AREA IS ADDED.

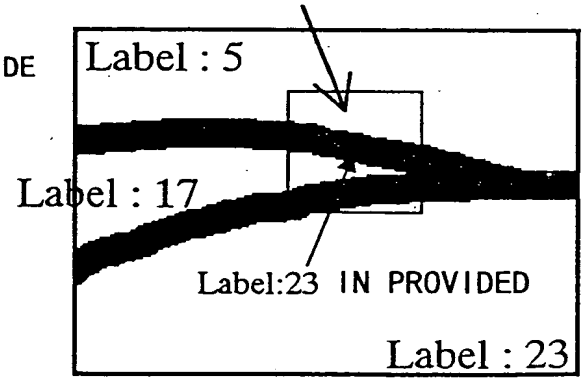


FIG.10D
PRIOR ART

THIS PART OF COLORED LINE
REMAINS UNCHANGED

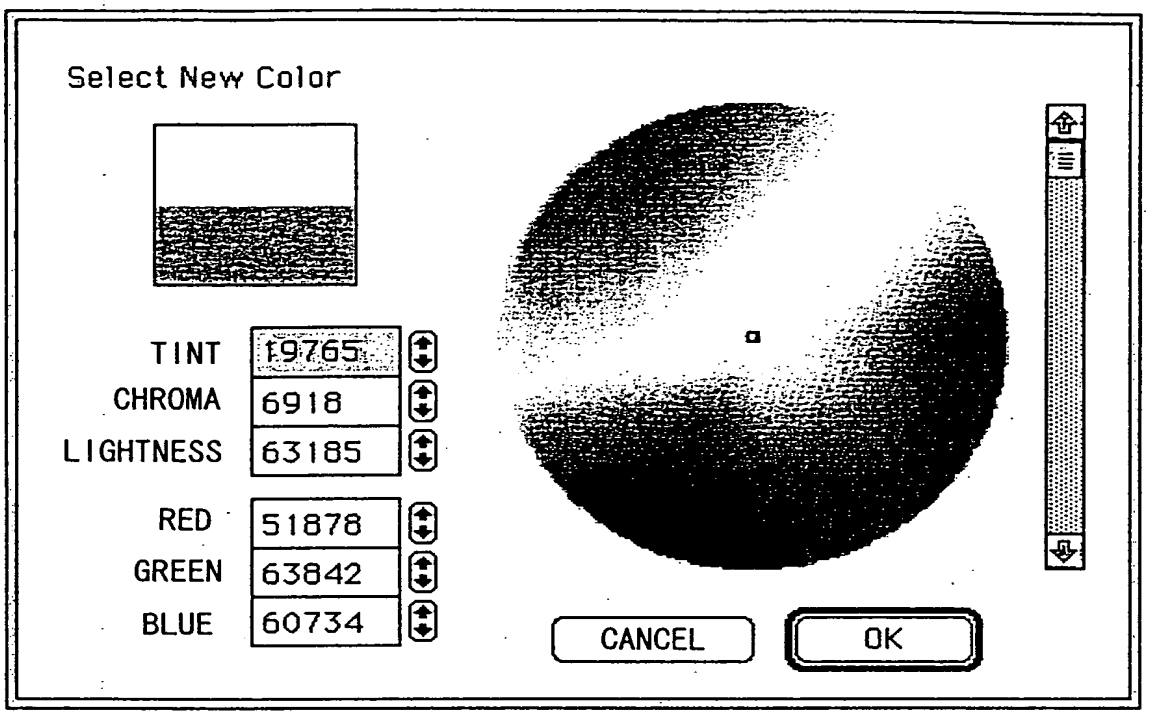


FIG.11A PRIOR ART

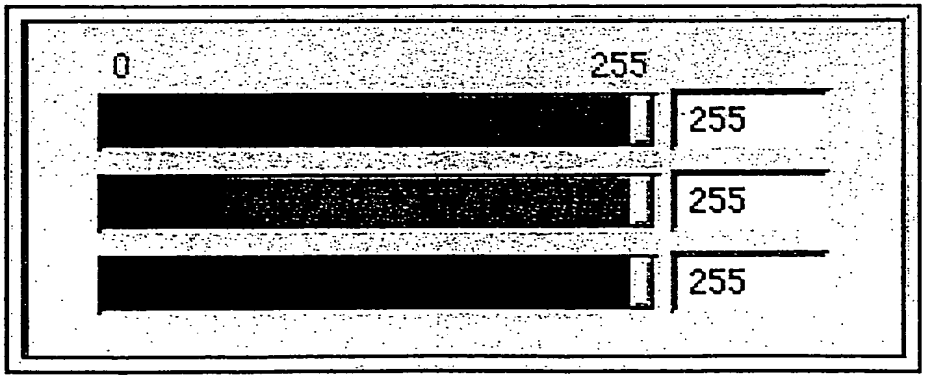


FIG.11B PRIOR ART

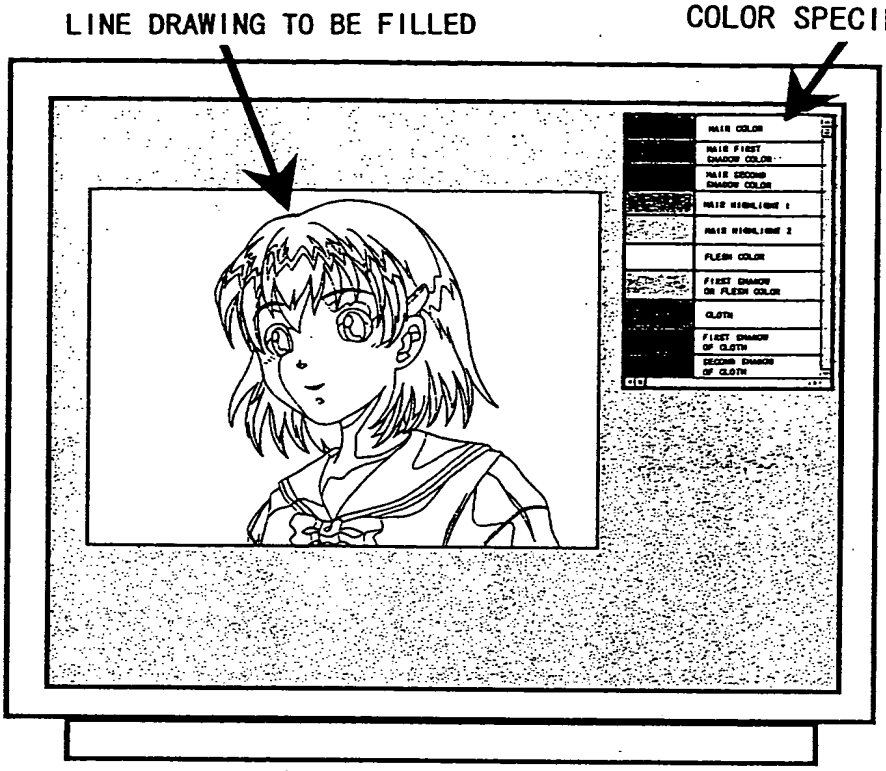


FIG.12A PRIOR ART

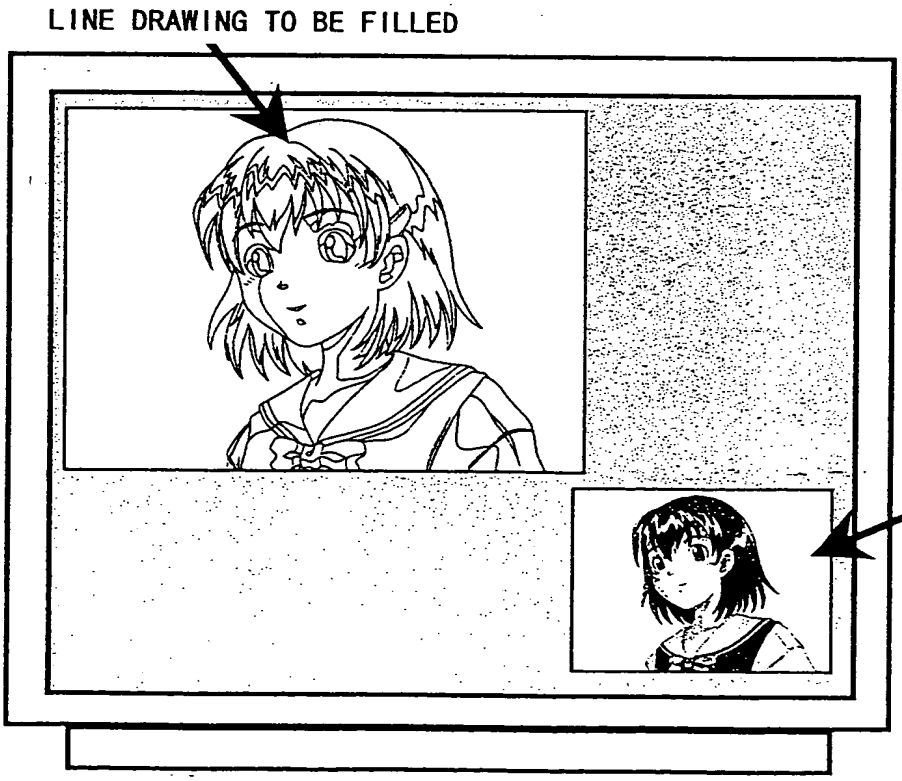


FIG.12B PRIOR ART

FIG. 13 PRIOR ART

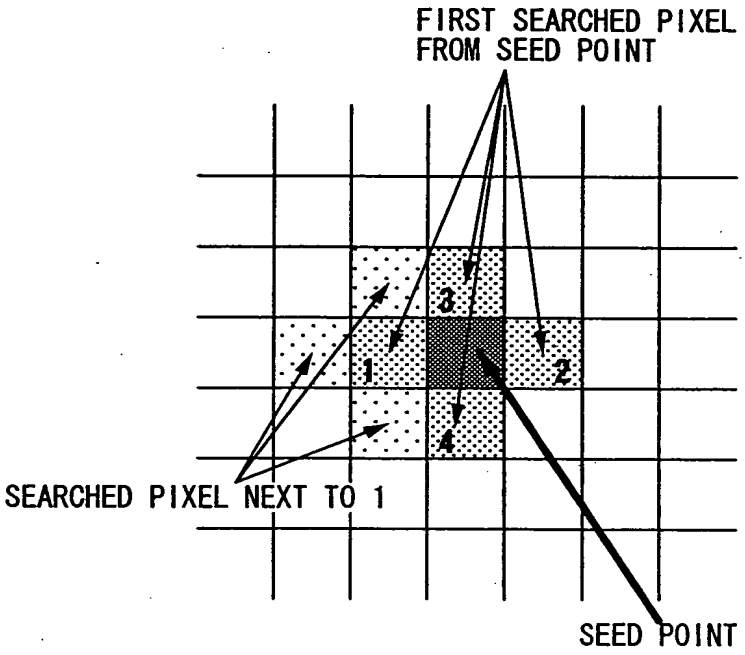


FIG. 14 PRIOR ART

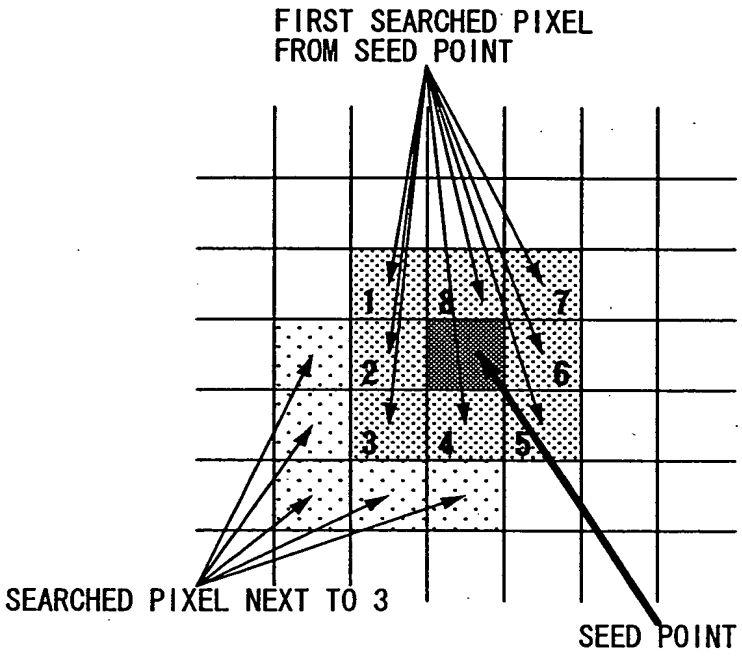
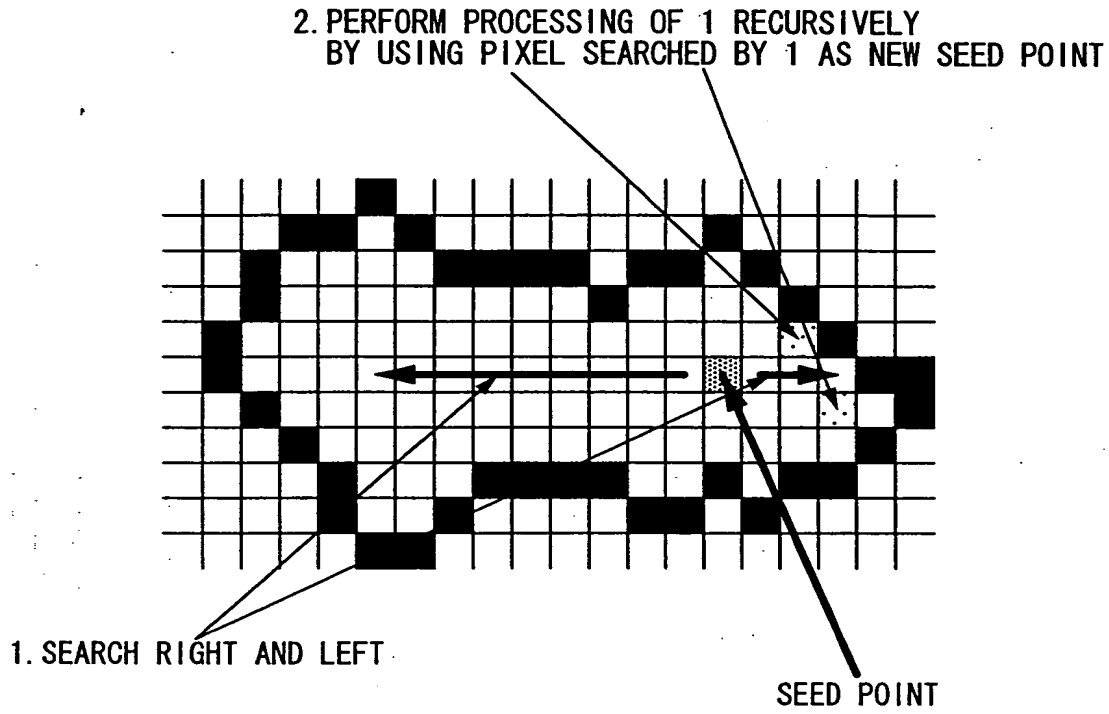


FIG. 15 PRIOR ART



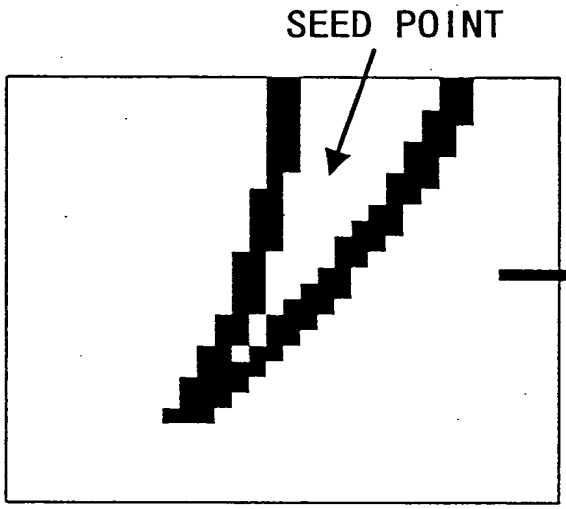


FIG.16A
PRIOR ART

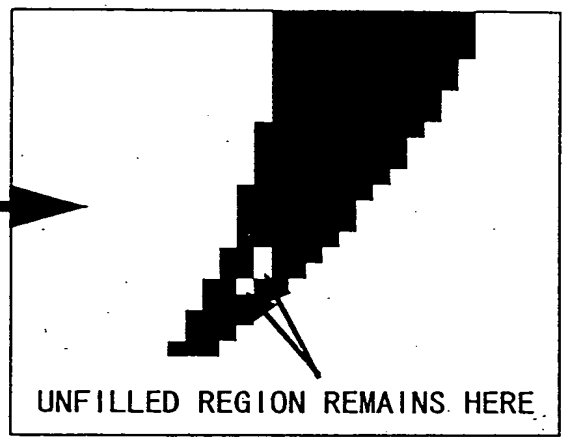


FIG.16B
PRIOR ART

FIG.17
PRIOR ART

FIG.18 PRIOR ART

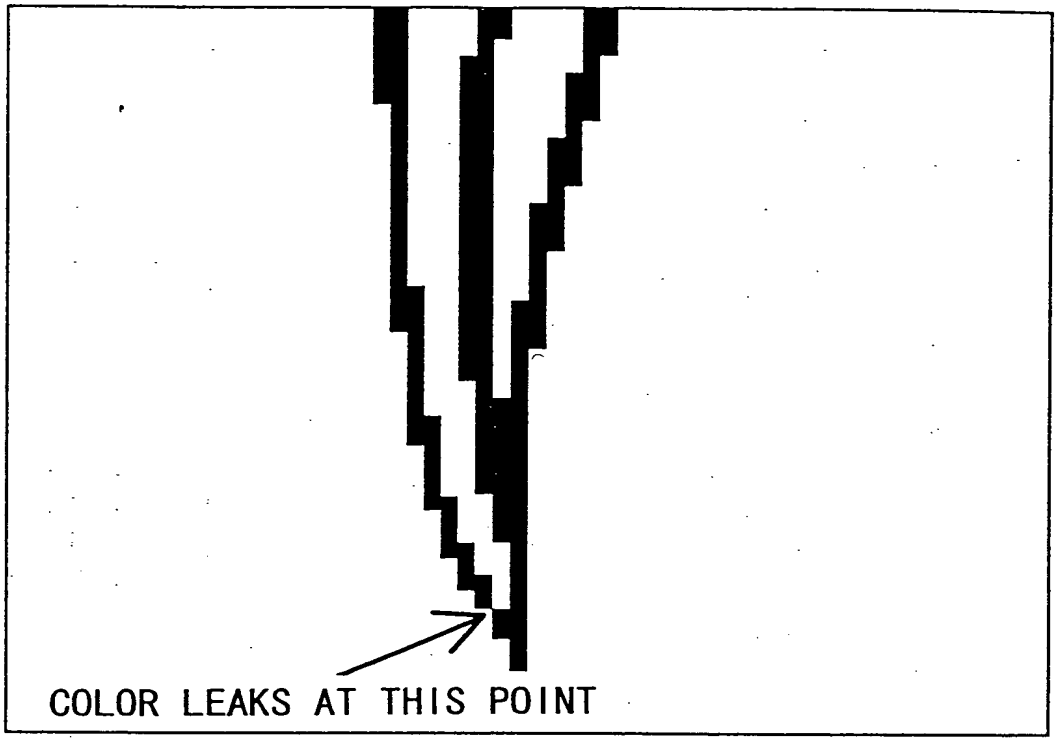


FIG. 19

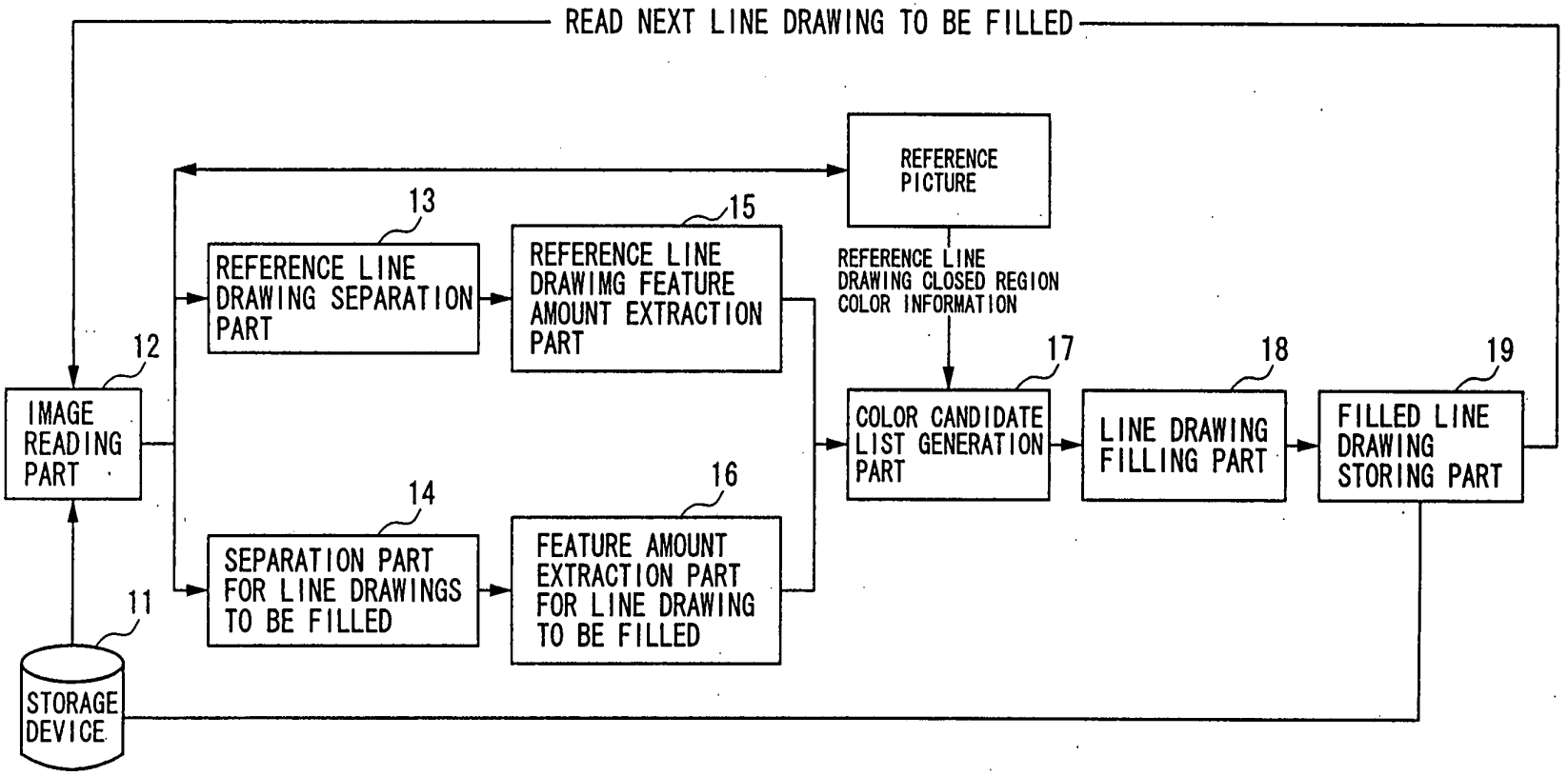

READ NEXT LINE DRAWING TO BE FILLED
REFERENCE PICTURE
13
15
REFERENCE LINE DRAWING SEPARATION PART
REFERENCE LINE DRAWIMG FEATURE AMOUNT EXTRACTION PART
REFERENCE LINE DRAWING CLOSED REGION COLOR INFORMATION
12
17
18
19
IMAGE READING PART
COLOR CANDIDATE LIST GENERATION PART
LINE DRAWING FILLING PART
FILLED LINE DRAWING STORING PART
14
16
SEPARATION PART FOR LINE DRAWINGS TO BE FILLED
FEATURE AMOUNT EXTRACTION PART FOR LINE DRAWING TO BE FILLED
11
STORAGE DEVICE

FIG.20

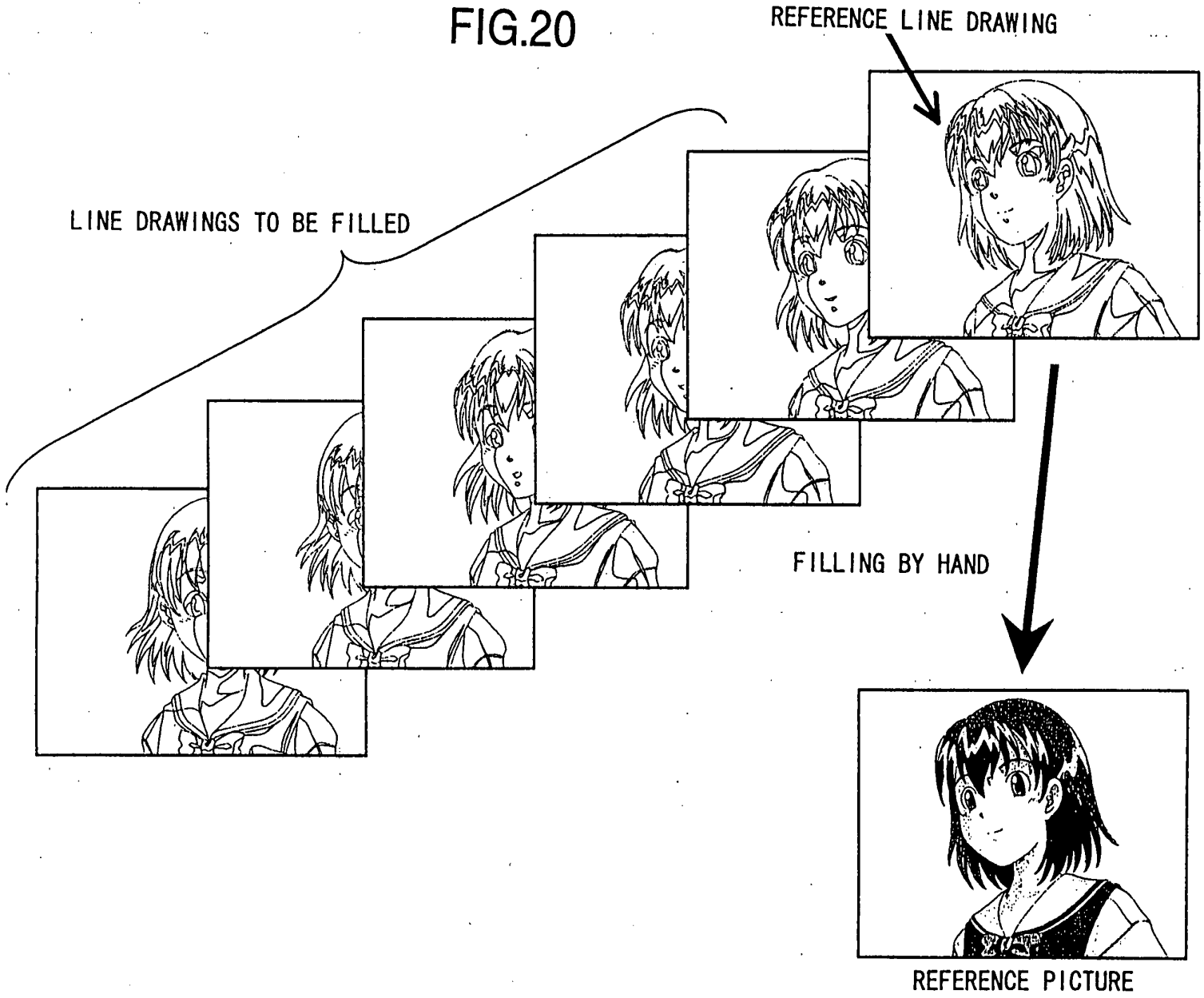

REFERENCE LINE DRAWING
LINE DRAWINGS TO BE FILLED
FILLING BY HAND
REFERENCE PICTURE

FIG. 21

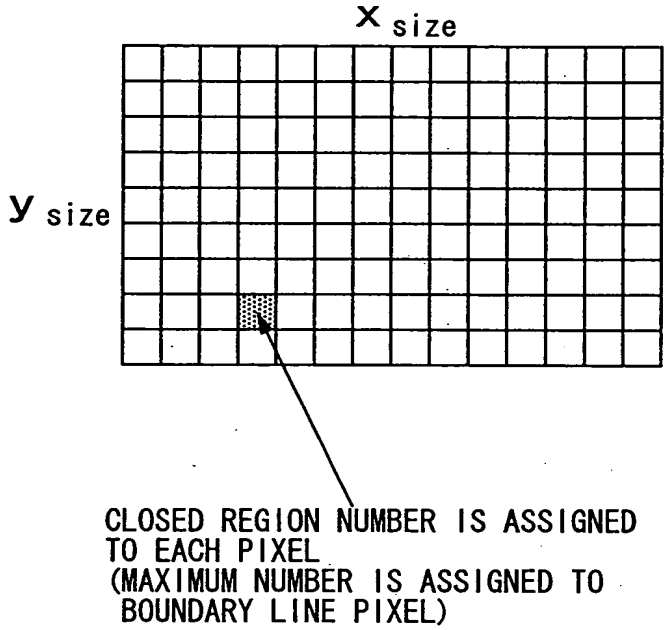

x size
y size
CLOSED REGION NUMBER IS ASSIGNED TO EACH PIXEL
(MAXIMUM NUMBER IS ASSIGNED TO BOUNDARY LINE PIXEL)

FIG. 22A

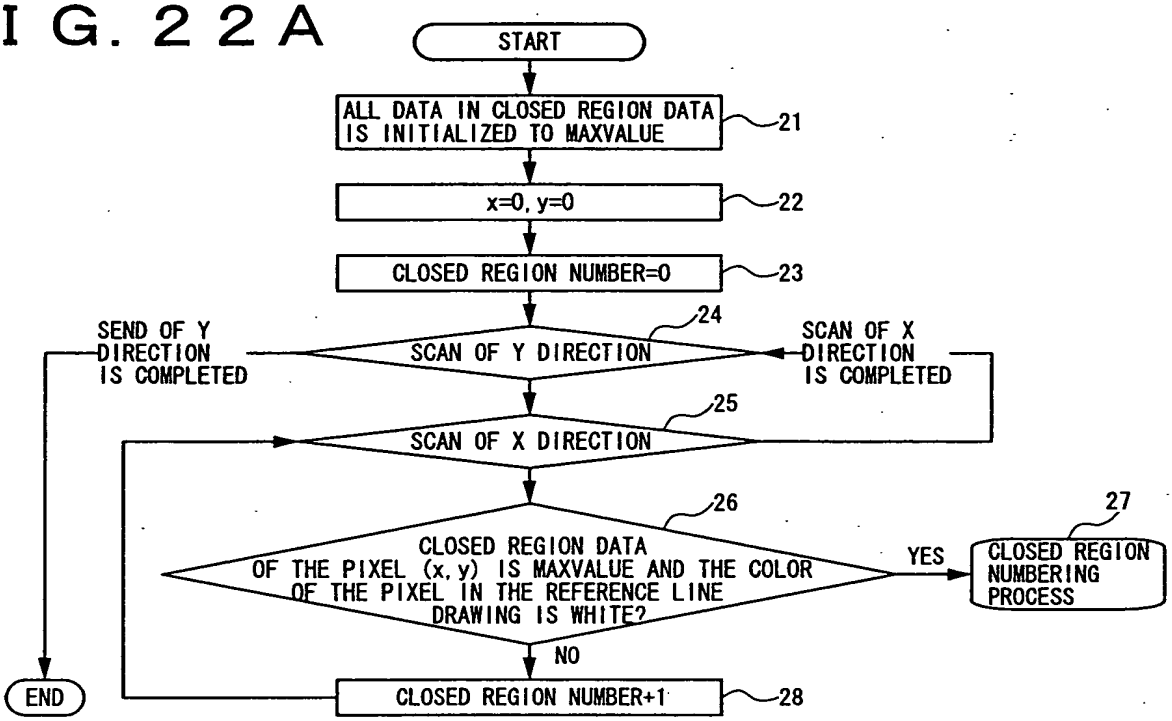
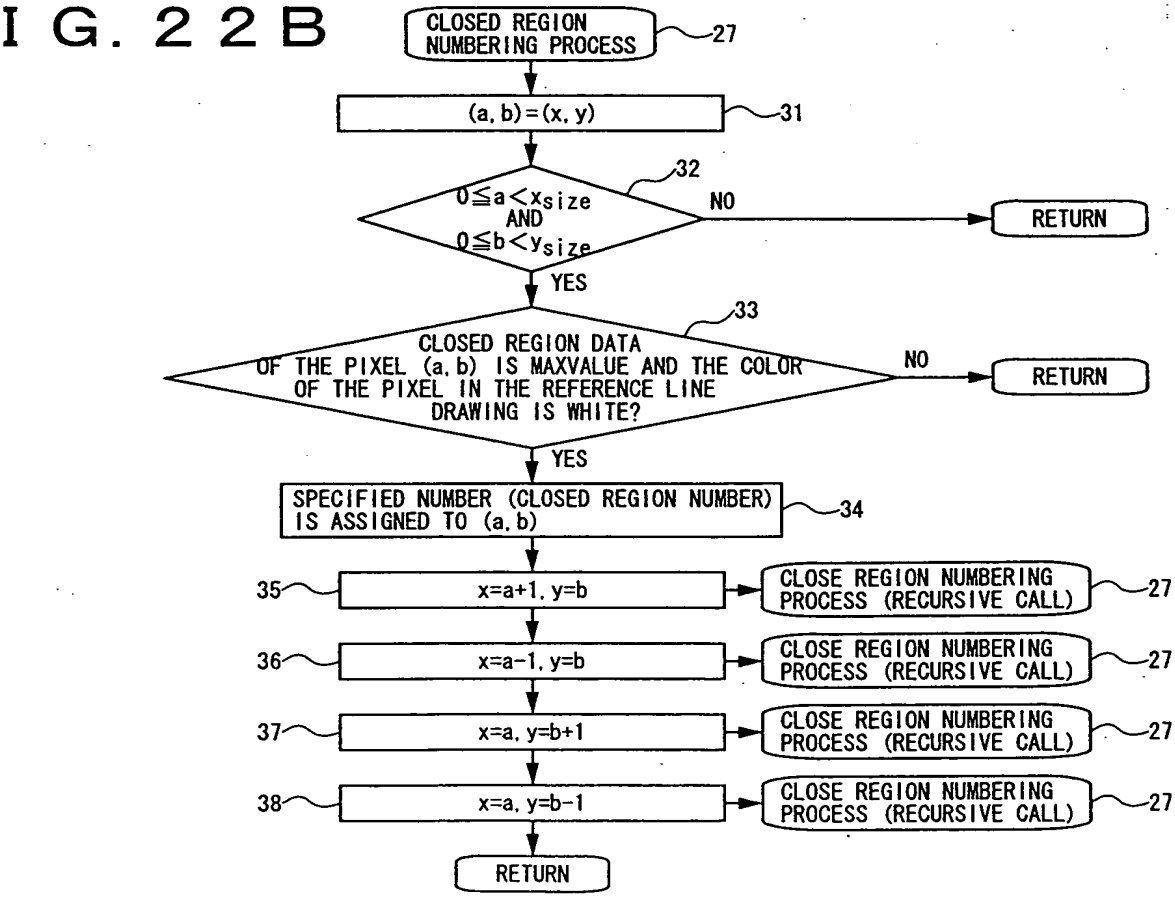


FIG. 22B



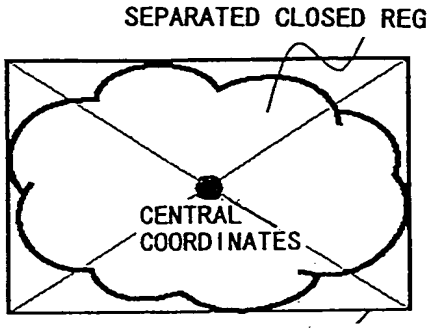


FIG.23A

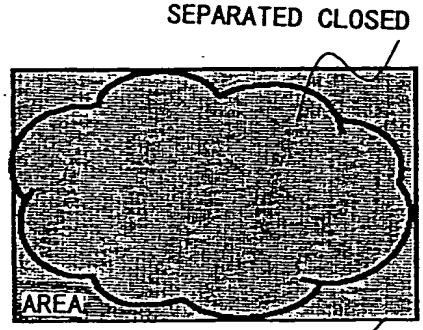


FIG.23B

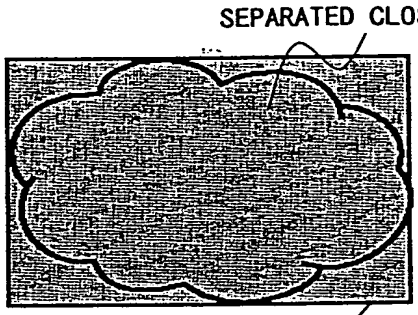


FIG.23C

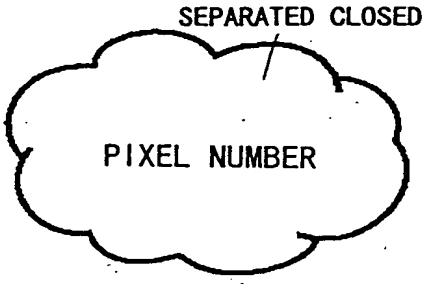


FIG.23D

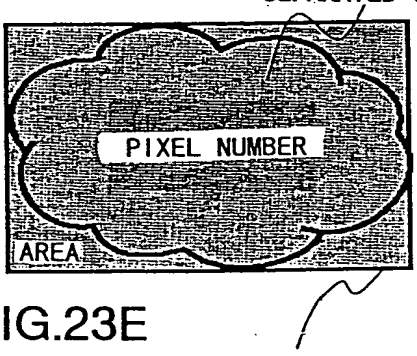


FIG.23E

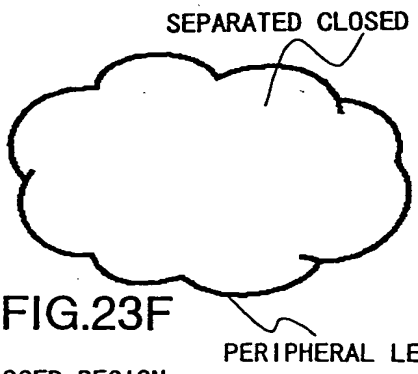


FIG.23F

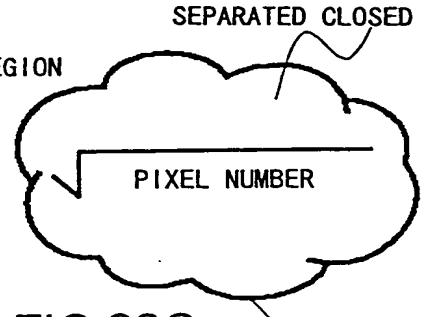


FIG.23G

FIG. 24A

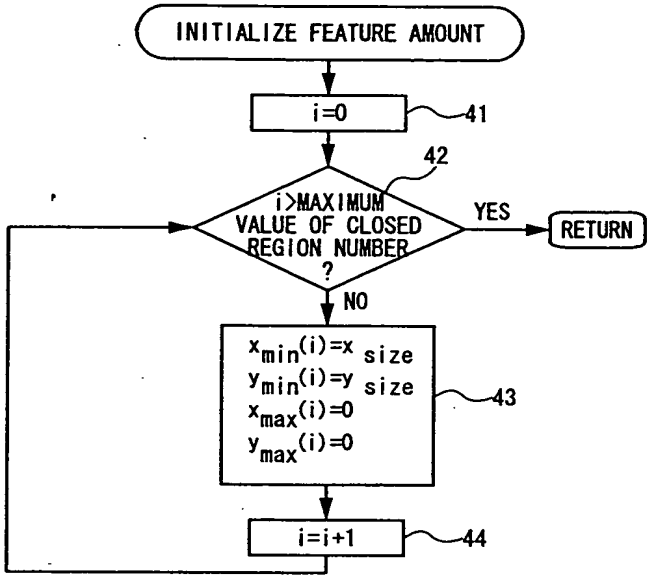


FIG. 24B

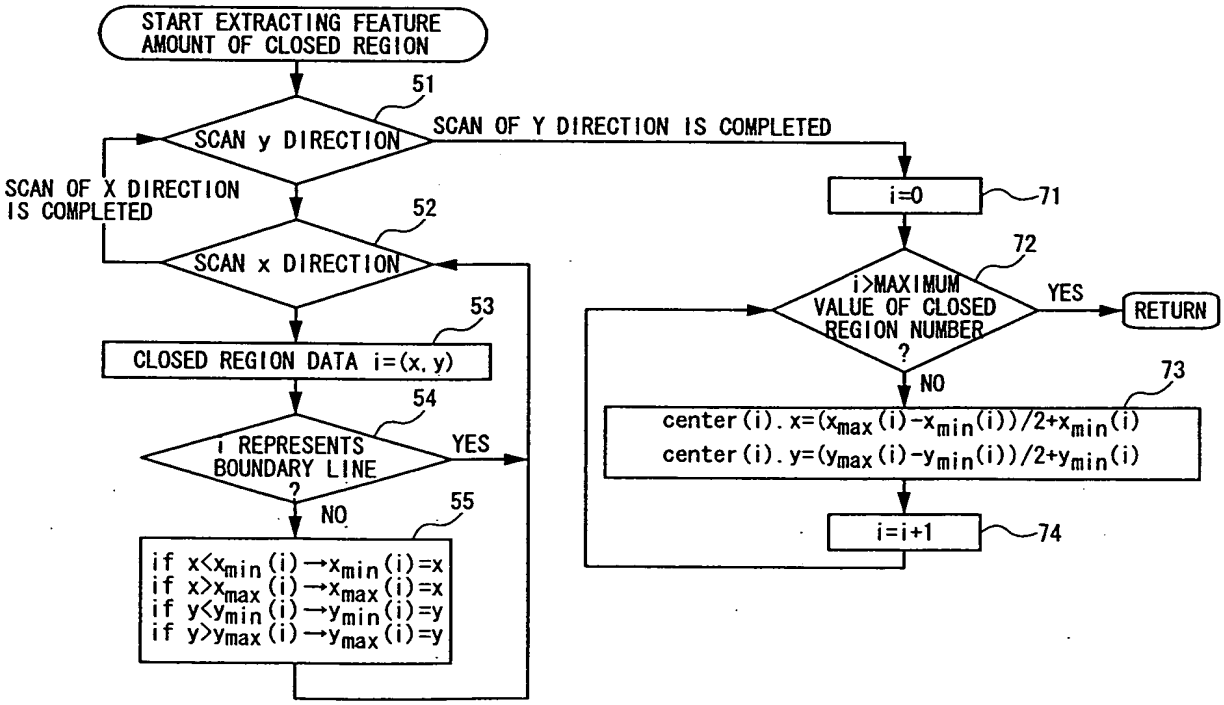


FIG. 25A

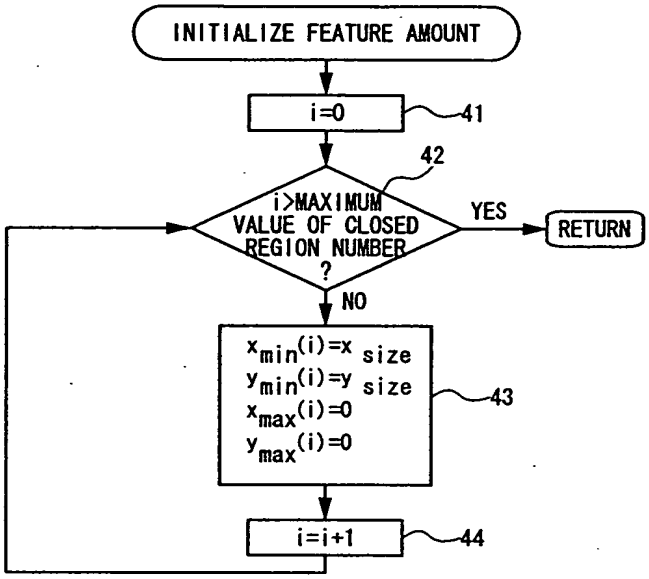


FIG. 25B

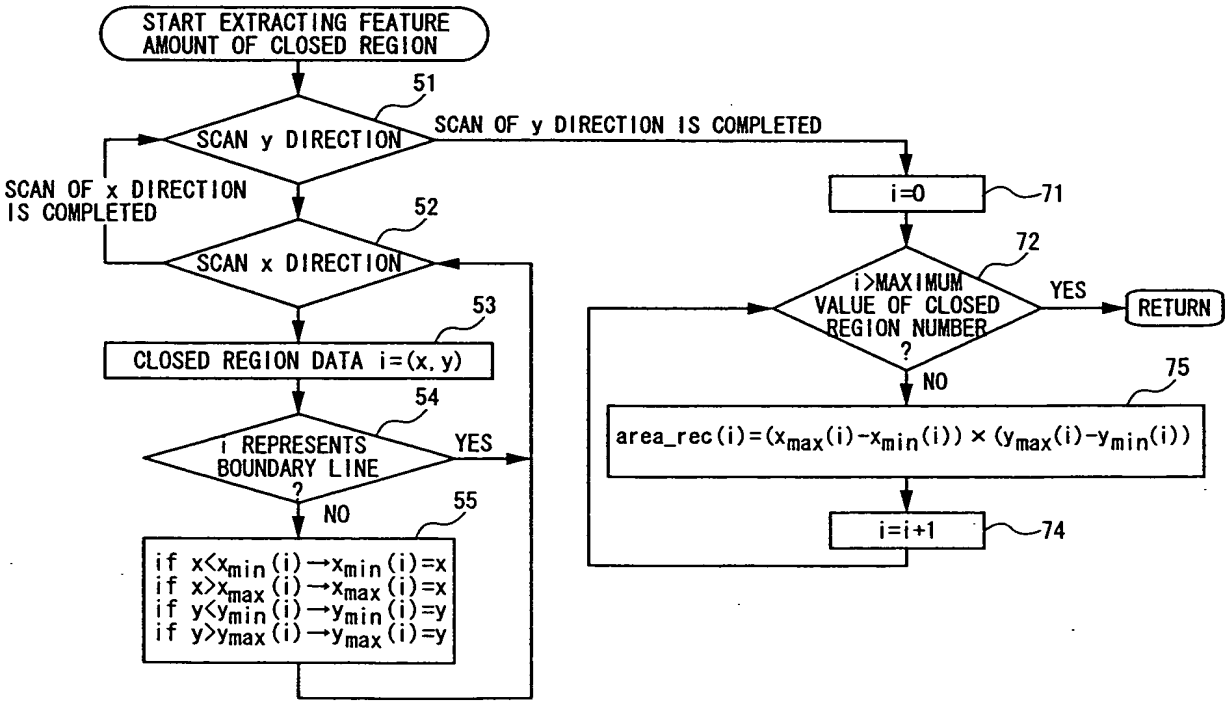


FIG. 26A

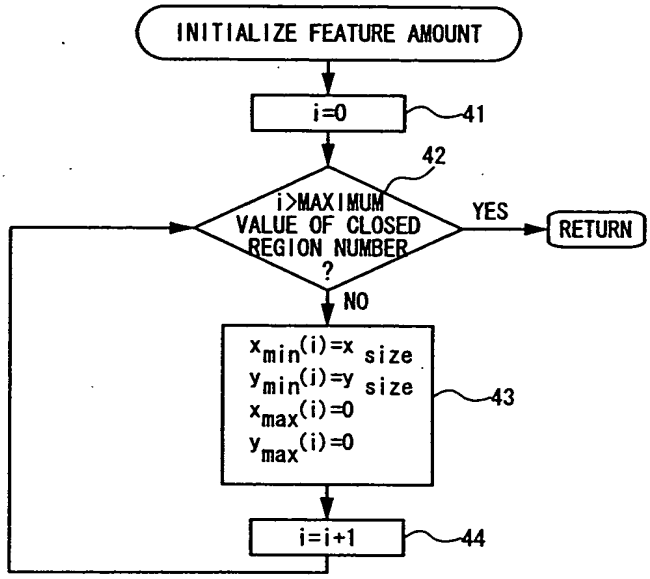


FIG. 26B

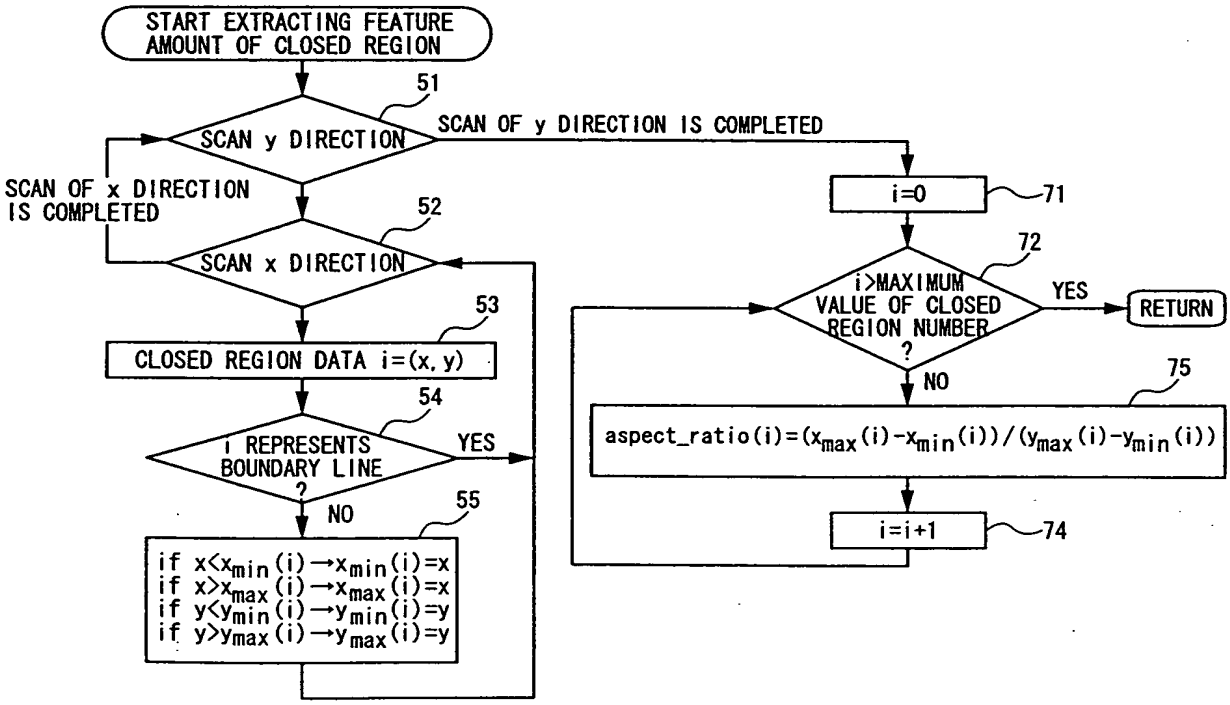


FIG. 27A

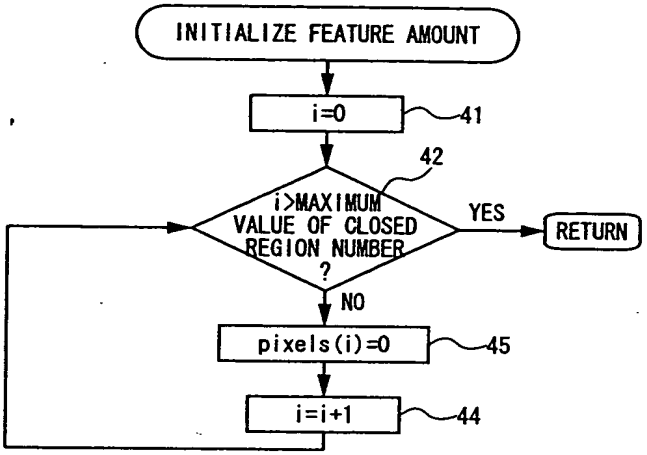


FIG. 27B

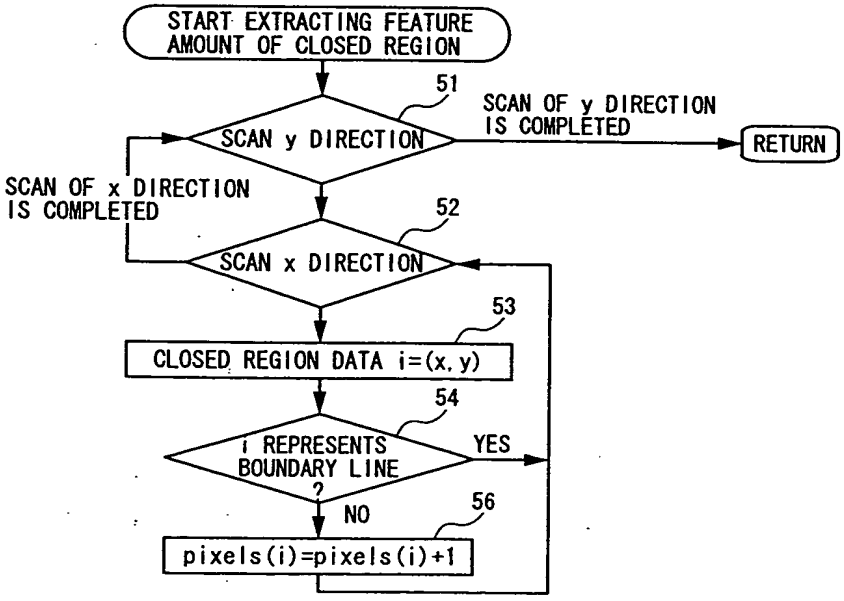


FIG. 28A

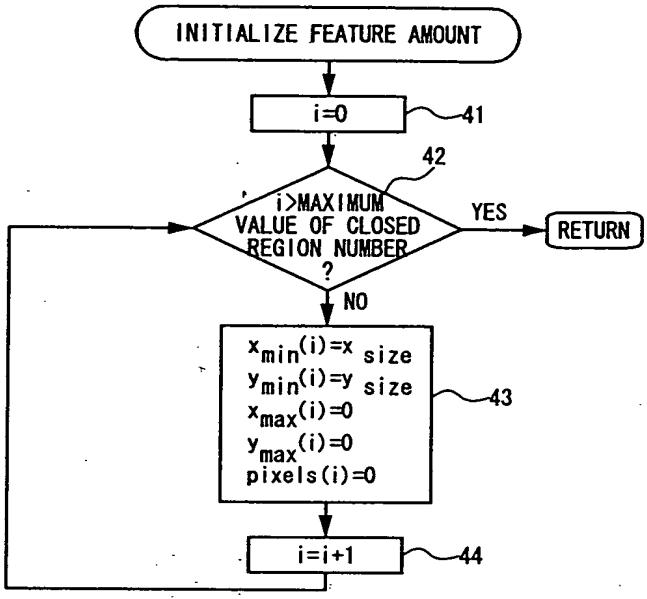


FIG. 28B

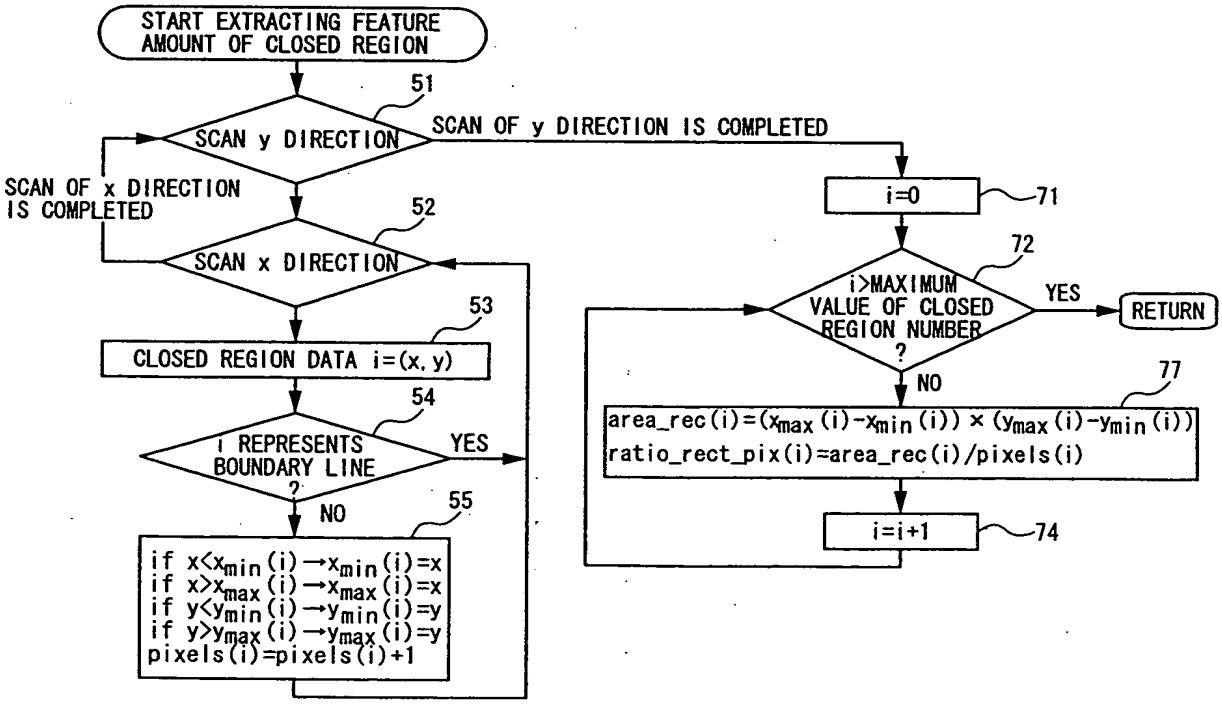


FIG. 29A

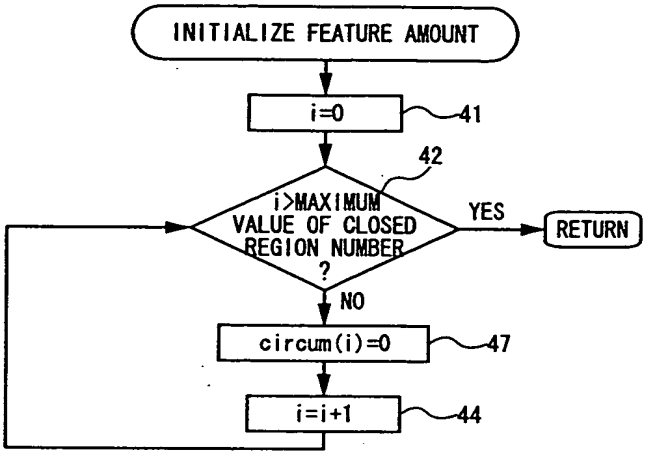


FIG. 29B

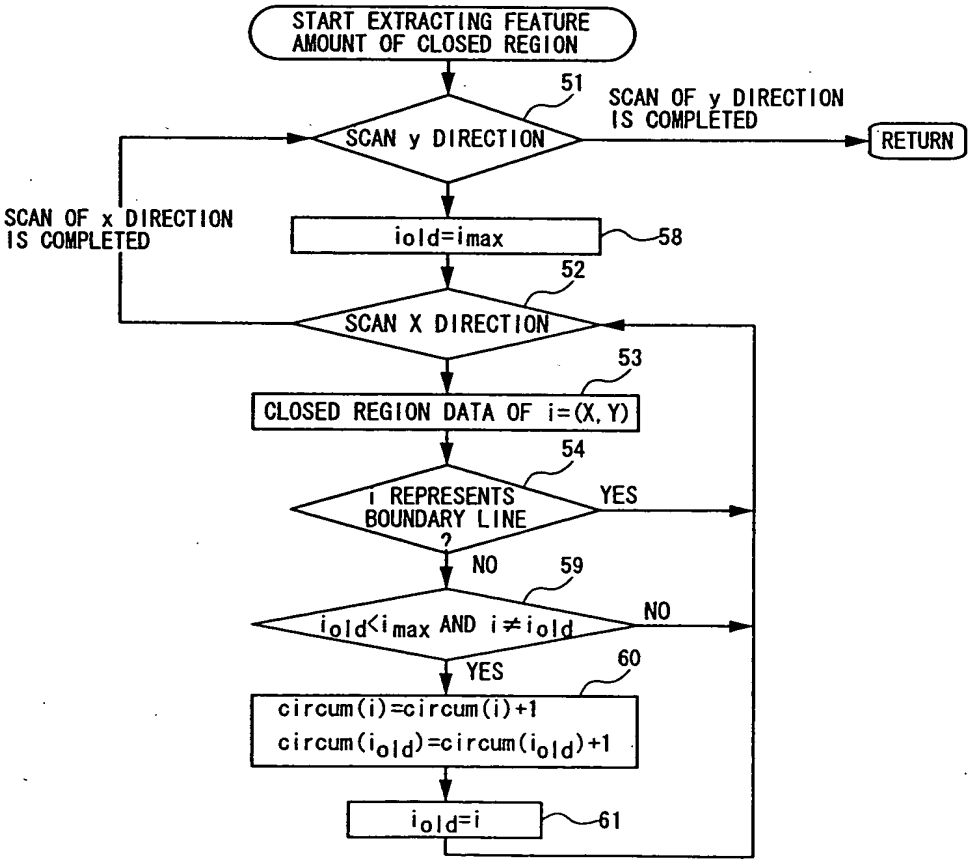


FIG. 30A

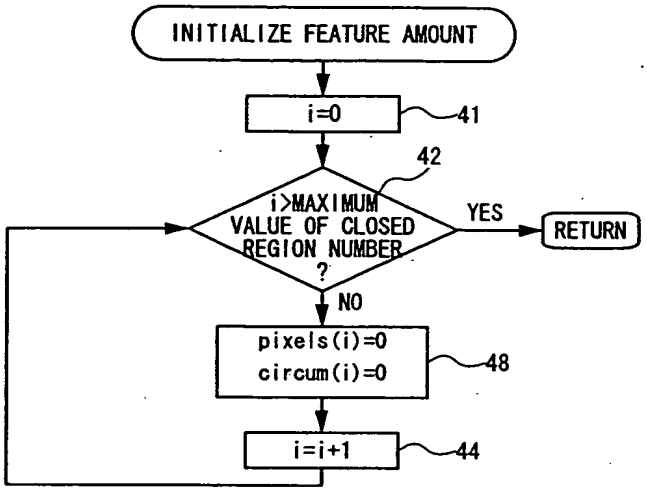


FIG. 30B

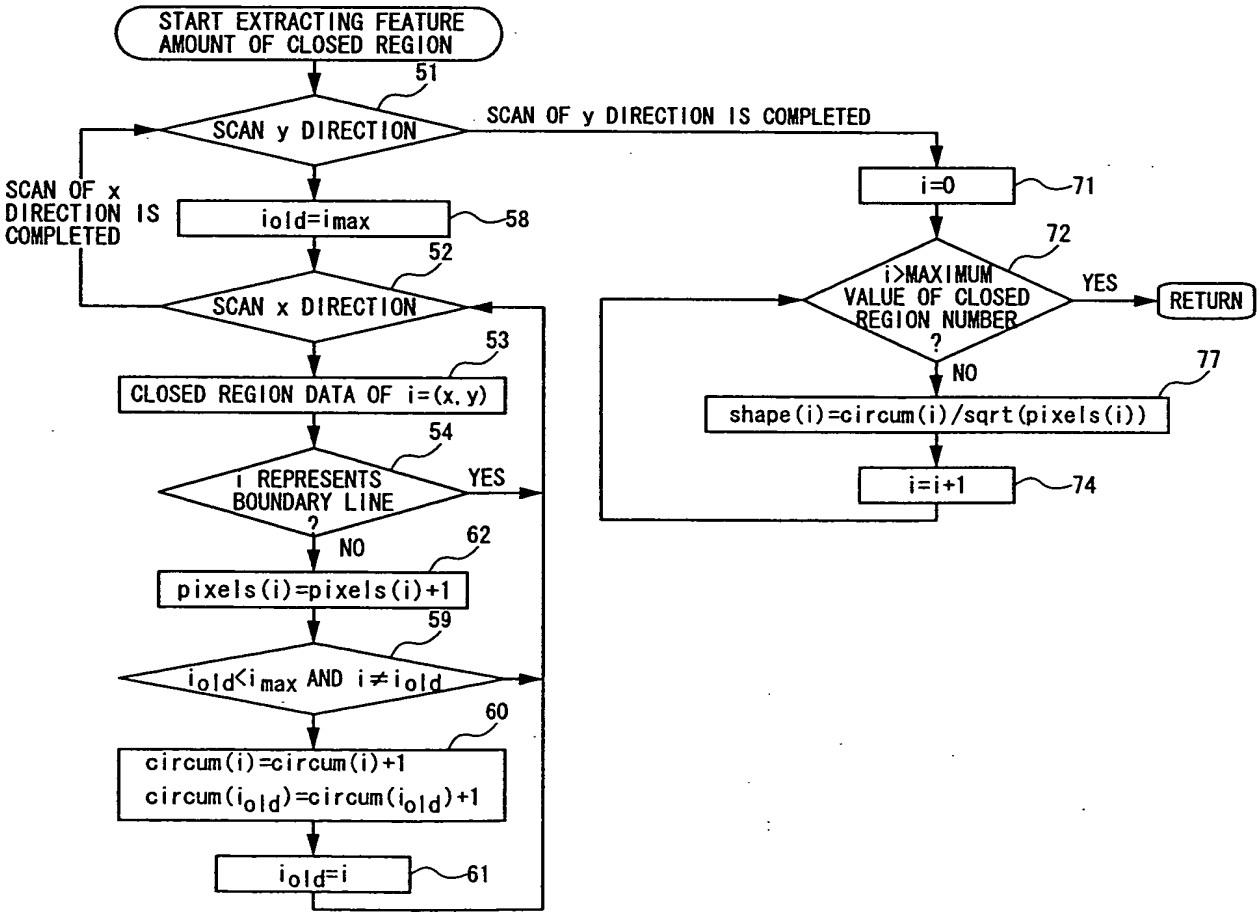


FIG. 31A

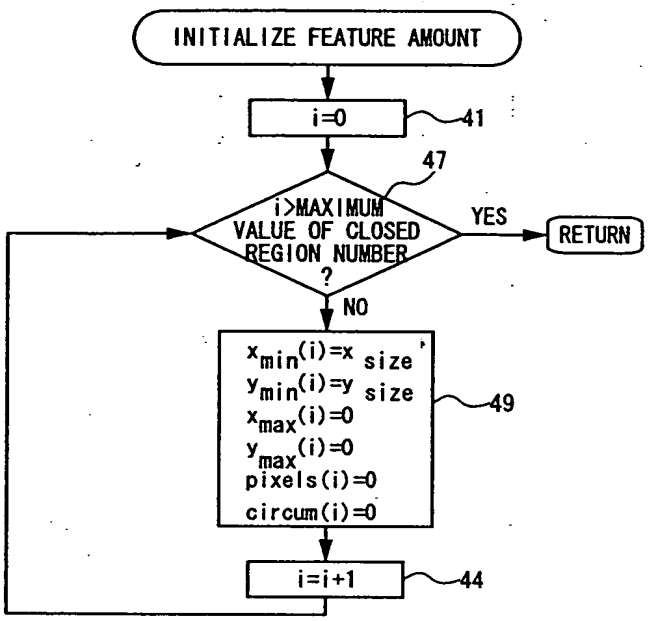


FIG. 31B

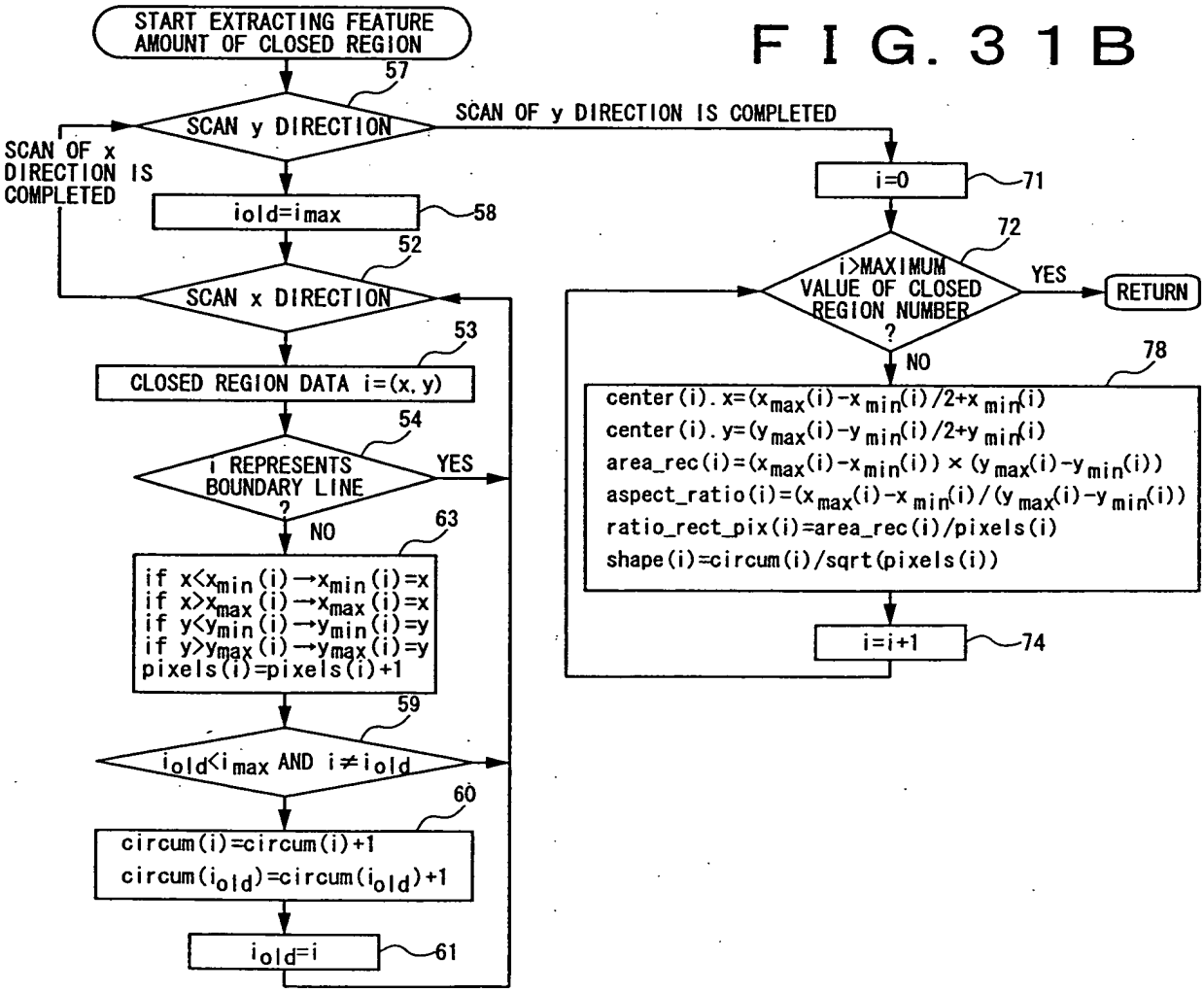


FIG. 32

REFERENCE LINE DRAWING					
CLOSED REGION NUMBER	FEATURE AMOUNT				
	1	2	3	4	5
1	(53, 184)	1428	0.5492	1232	1.159
2	(186, 232)	11408	1.348	8462	1.348
3	(465, 339)	49698	1.268	32918	1.300
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.

FIG. 33

LINE DRAWING TO BE FILLED	REFERENCE LINE DRAWING		
	FEATURE AMOUNT 1		...
CLOSED REGION NUMBER	CLOSED REGION NUMBER	VARIATION AMOUNT	...
0	0	0.000000	...
	1	30.41381	...
	2	31.62277	...
	3	42.05948	...
1	1	2.236068	...
	2	6.324555	...
	3	21.18962	...
	0	28.28427	...
2	1	6.324555	...
	2	12.20655	...
	3	25.80697	...
	0	33.83784	...
:	:	:	

FIG. 34

LINE DRAWING TO BE FILLED	REFERENCE LINE DRAWING		
	FEATURE AMOUNT 1		...
CLOSED REGION NUMBER	CLOSED REGION NUMBER	NORMARIZED AMOUNT	...
0	0	0.000000	...
	1	0.723114	...
	2	0.751858	...
	3	1.000000	...
1	1	0.000000	...
	2	0.156959	...
	3	0.727634	...
	0	1.000000	...
2	1	0.000000	...
	2	0.213788	...
	3	0.708109	...
	0	1.000000	...
:	:	:	

FIG. 35

LINE DRAWING TO BE FILLED	REFERENCE LINE DRAWING	
	INTEGRATED VARIATION AMOUNT	
CLOSED REGION NUMBER	CLOSED REGION NUMBER	VALUE
0	0	0.000000
	1	4.522894
	2	4.618271
	3	4.678329
1	1	0.093134
	2	1.454905
	3	4.047636
	0	4.735393
2	1	0.006086
	2	0.078106
	3	2.898299
	0	3.320228
:	:	:

FIG. 36

LINE DRAWING TO BE FILLED	REFERENCE LINE DRAWING		COLOR OF CLOSED REGION CORRESPONDING TO REFERENCE PICTURE	COLOR CANDIDATE LISTS IN WHICH DUPLICATION IS ELIMINATED
	INTEGRATED VARIATION AMOUNT			
CLOSED REGION NUMBER	CLOSED REGION NUMBER	VALUE		
0	0	0.000000	249, 194, 194	249, 194, 194
	1	4.522894	254, 0, 0	254, 0, 0
	2	4.618271	254, 0, 0	116, 252, 116
	3	4.678329	116, 252, 116	
1	1	0.093134	254, 0, 0	254, 0, 0
	2	1.454905	116, 252, 116	116, 252, 116
	3	4.047636	249, 194, 194	249, 194, 194
	0	4.735393	254, 0, 0	
2	1	0.006086	116, 252, 116	116, 252, 116
	2	0.078106	254, 0, 0	254, 0, 0
	3	2.898299	254, 0, 0	249, 194, 194
	0	3.320228	249, 194, 194	
:	:	:	:	:

FIG. 37A

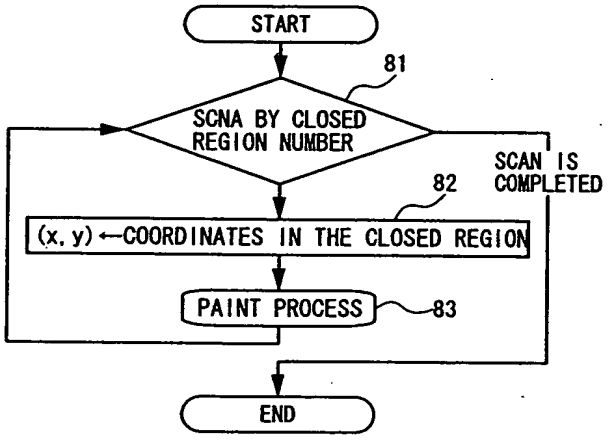


FIG. 37B

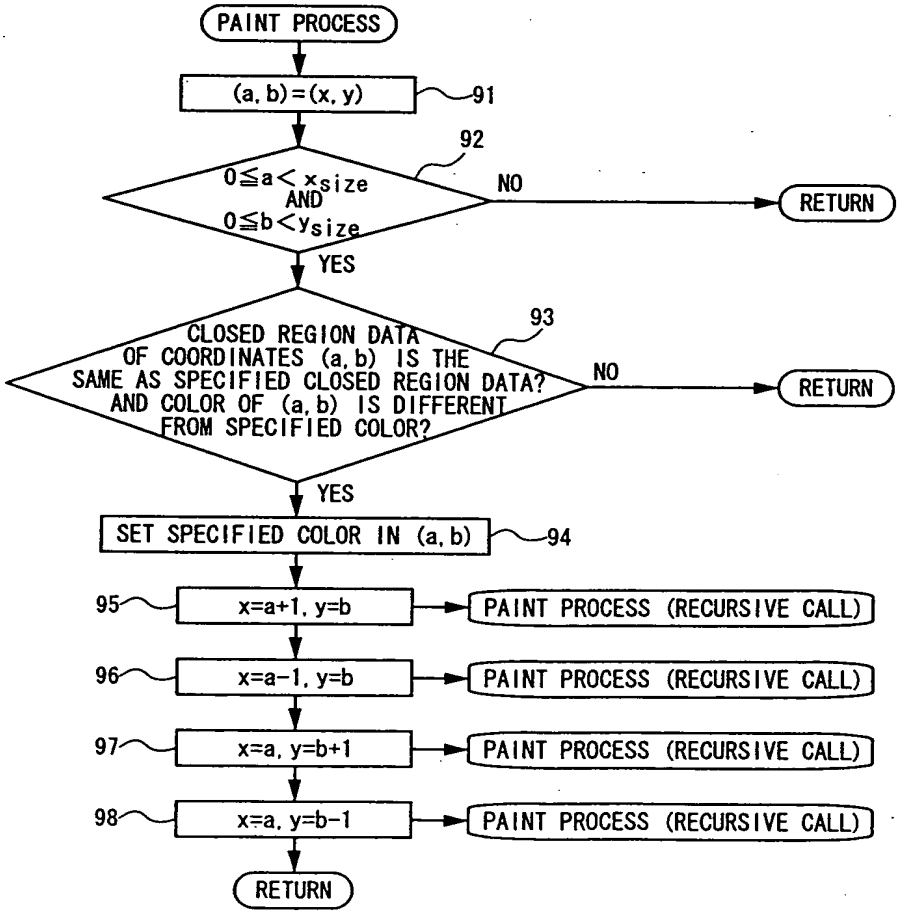


FIG. 38

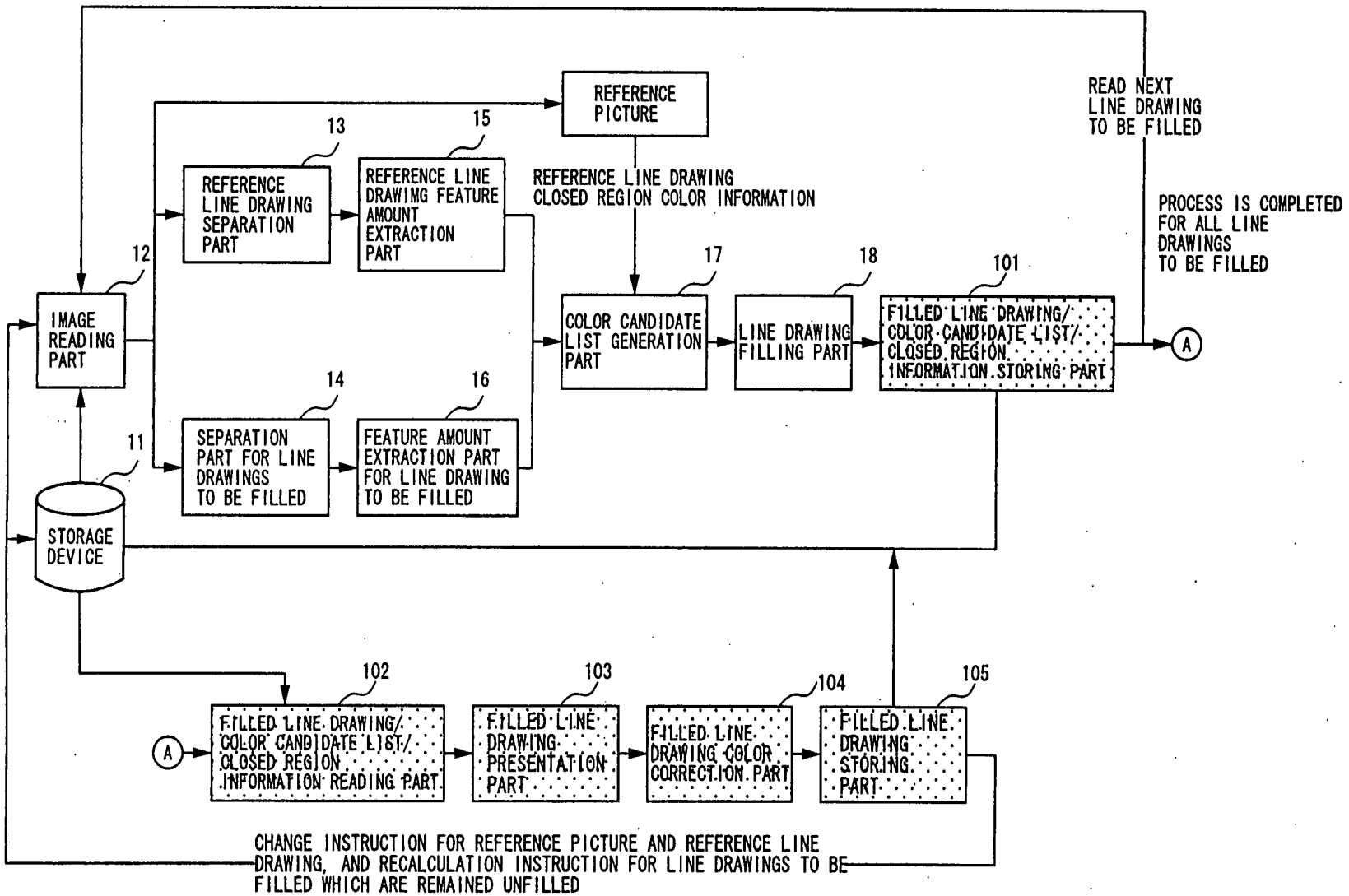

REFERENCE PICTURE
READ NEXT LINE DRAWING TO BE FILLED
13
15
REFERENCE LINE DRAWING SEPARATION PART
REFERENCE LINE DRAWIMG FEATURE AMOUNT EXTRACTION PART
REFERENCE LINE DRAWING CLOSED REGION COLOR INFORMATION
PROCESS IS COMPLETED FOR ALL LINE DRAWINGS TO BE FILLED
12
17
18
101
IMAGE READING PART
COLOR CANDIDATE LIST GENERATION PART
LINE DRAWING FILLING PART
FILLED LINE DRAWING/ COLOR CANDIDATE LIST/ CLOSED REGION INFORMATION STORING PART
A
14
16
11
SEPARATION PART FOR LINE DRAWINGS TO BE FILLED
FEATURE AMOUNT EXTRACTION PART FOR LINE DRAWING TO BE FILLED
STORAGE DEVICE
102
103
104
105
A
FILLED LINE DRAWING/ COLOR CANDIDATE LIST/ CLOSED REGION INFORMATION READING PART
FILLED LINE DRAWING PRESENTATION PART
FILLED LINE DRAWING COLOR CORRECTION PART
FILLED LINE DRAWING STORING PART
CHANGE INSTRUCTION FOR REFERENCE PICTURE AND REFERENCE LINE DRAWING, AND RECALCULATION INSTRUCTION FOR LINE DRAWINGS TO BE FILLED WHICH ARE REMAINED UNFILLED

FIG.39

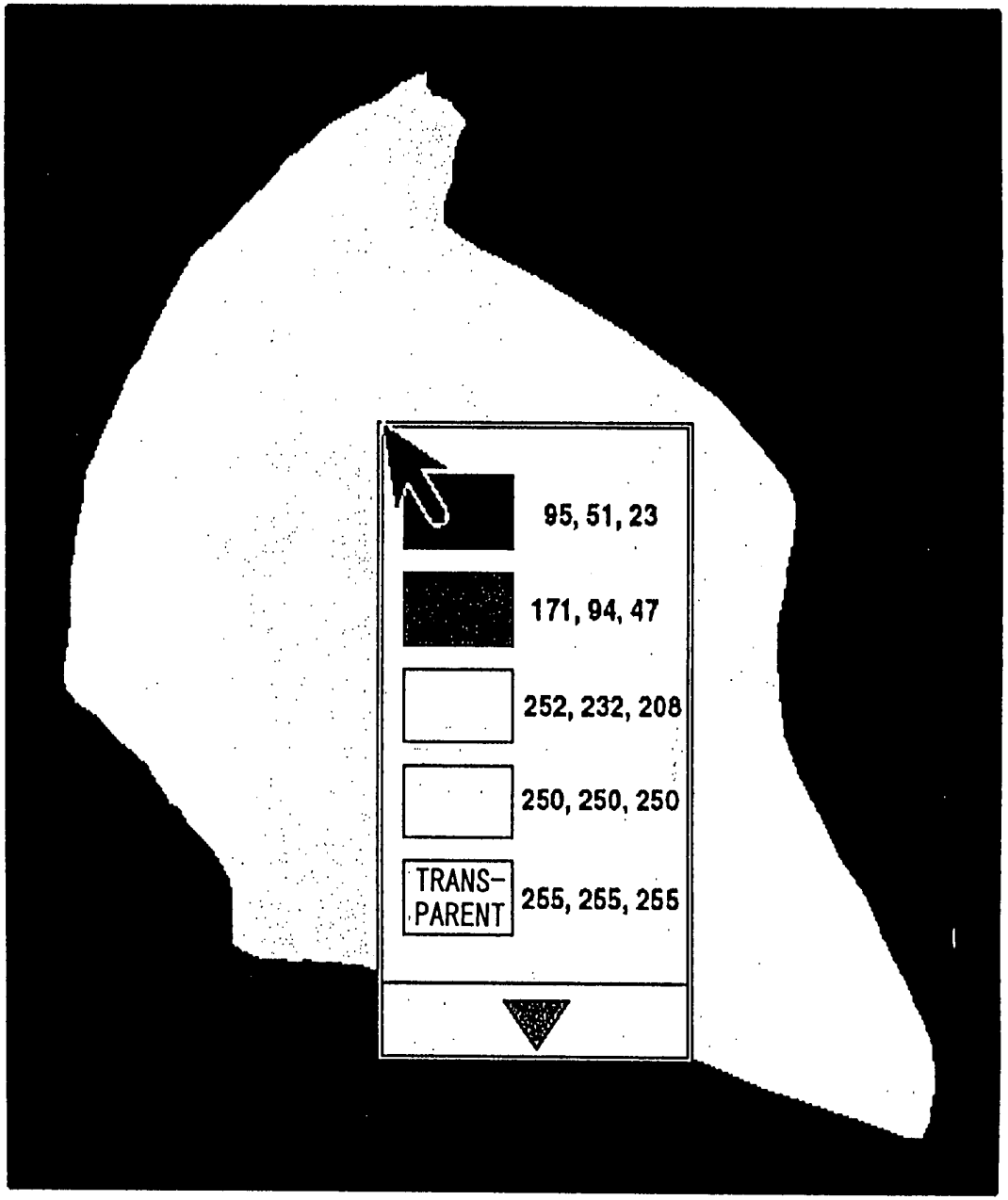

95, 51, 23
171, 94, 47
252, 232, 208
250, 250, 250
TRANS-
PARENT
255, 255, 255

FIG. 40

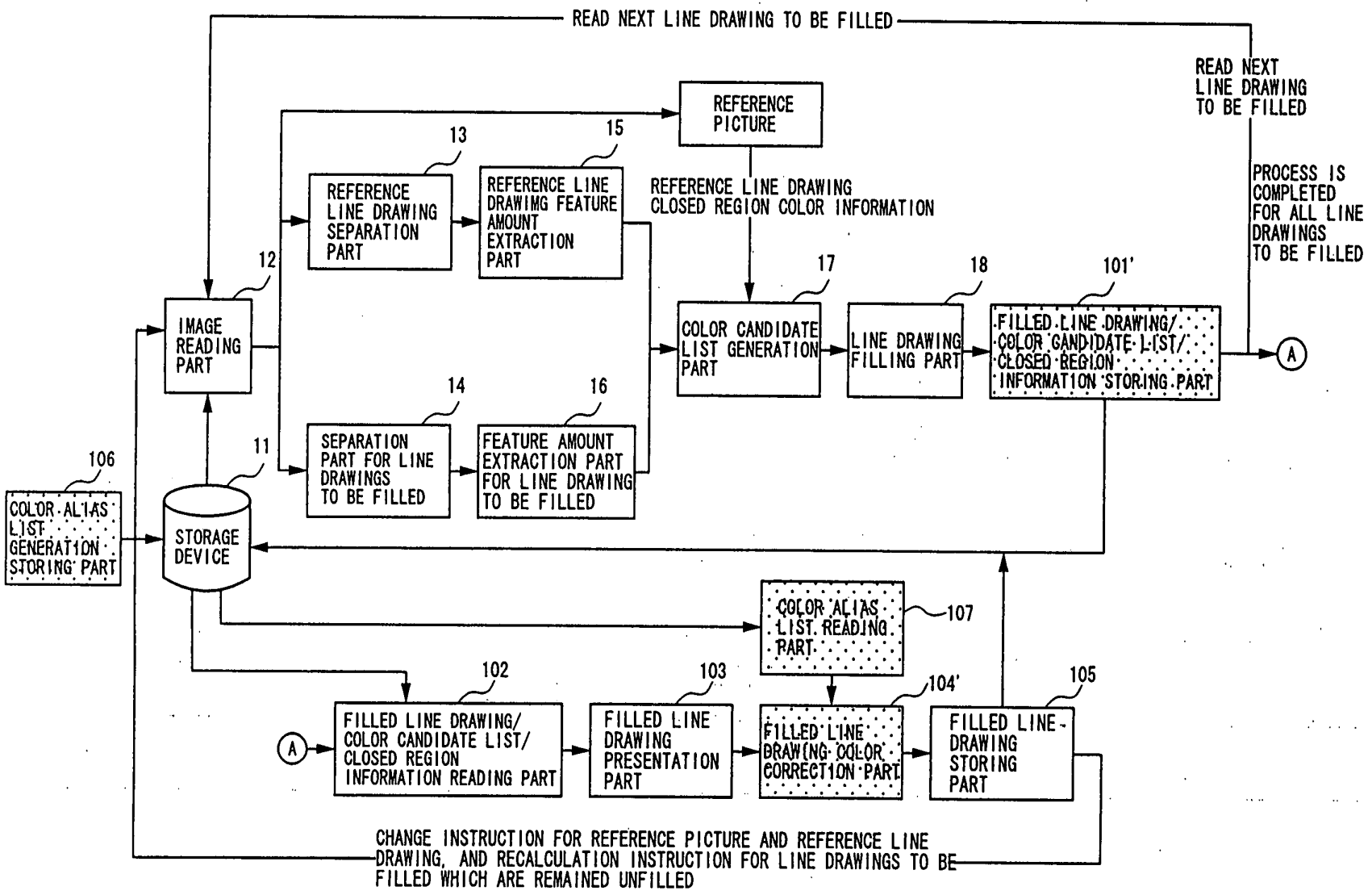

READ NEXT LINE DRAWING TO BE FILLED
READ NEXT LINE DRAWING TO BE FILLED
PROCESS IS COMPLETED FOR ALL LINE DRAWINGS TO BE FILLED
REFERENCE PICTURE
REFERENCE LINE DRAWING CLOSED REGION COLOR INFORMATION
13
15
REFERENCE LINE DRAWING SEPARATION PART
REFERENCE LINE DRAWIMG FEATURE AMOUNT EXTRACTION PART
12
17
18
101'
IMAGE READING PART
COLOR CANDIDATE LIST GENERATION PART
LINE DRAWING FILLING PART
FILLED LINE DRAWING/ COLOR CANDIDATE LIST/ CLOSED REGION INFORMATION STORING PART
A
14
16
106
11
SEPARATION PART FOR LINE DRAWINGS TO BE FILLED
FEATURE AMOUNT EXTRACTION PART FOR LINE DRAWING TO BE FILLED
COLOR ALIAS LIST GENERATION STORING PART
STORAGE DEVICE
COLOR ALIAS LIST READING PART
107
102
103
104'
105
A
FILLED LINE DRAWING/ COLOR CANDIDATE LIST/ CLOSED REGION INFORMATION READING PART
FILLED LINE DRAWING PRESENTATION PART
FILLED LINE DRAWING COLOR CORRECTION PART
FILLED LINE DRAWING STORING PART
CHANGE INSTRUCTION FOR REFERENCE PICTURE AND REFERENCE LINE DRAWING, AND RECALCULATION INSTRUCTION FOR LINE DRAWINGS TO BE FILLED WHICH ARE REMAINED UNFILLED

FIG.41

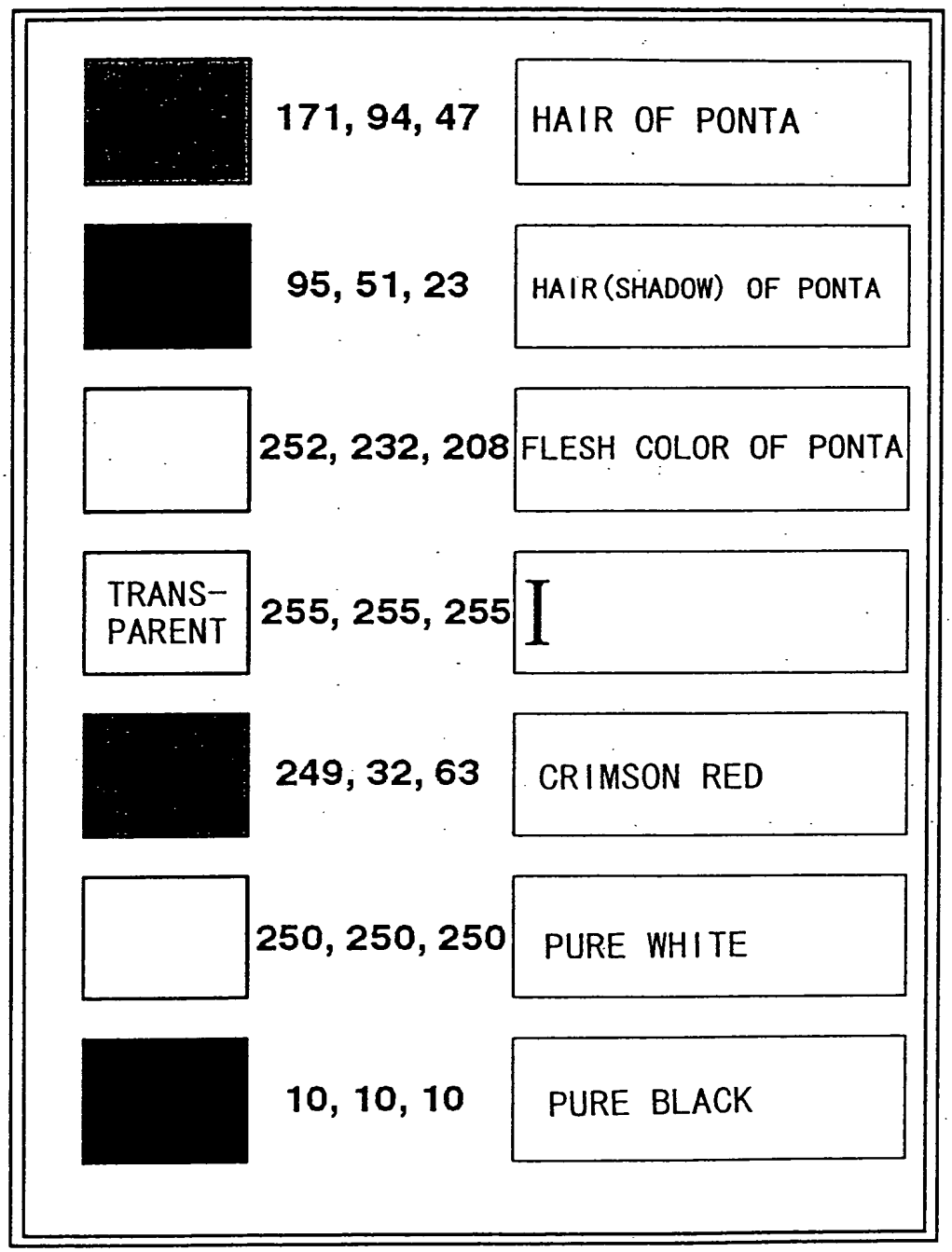

171, 94, 47
HAIR OF PONTA
95, 51, 23
HAIR(SHADOW) OF PONTA
252, 232, 208
FLESH COLOR OF PONTA
TRANS-PARENT
255, 255, 255
249, 32, 63
CRIMSON RED
250, 250, 250
PURE WHITE
10, 10, 10
PURE BLACK

FIG. 42

COLOR (R, G, B)	COLOR ALIAS
171, 94, 47	HAIR OF PONTA
95, 51, 23	HAIR (SHADOW) OF PONTA
252, 232, 208	FLESH COLOR OF PONTA
255, 255, 255	TRANSPARENT
249, 32, 63	CRIMSON RED
250, 250, 250	PURE WHITE
10, 10, 10	PURE BLACK

FIG.43

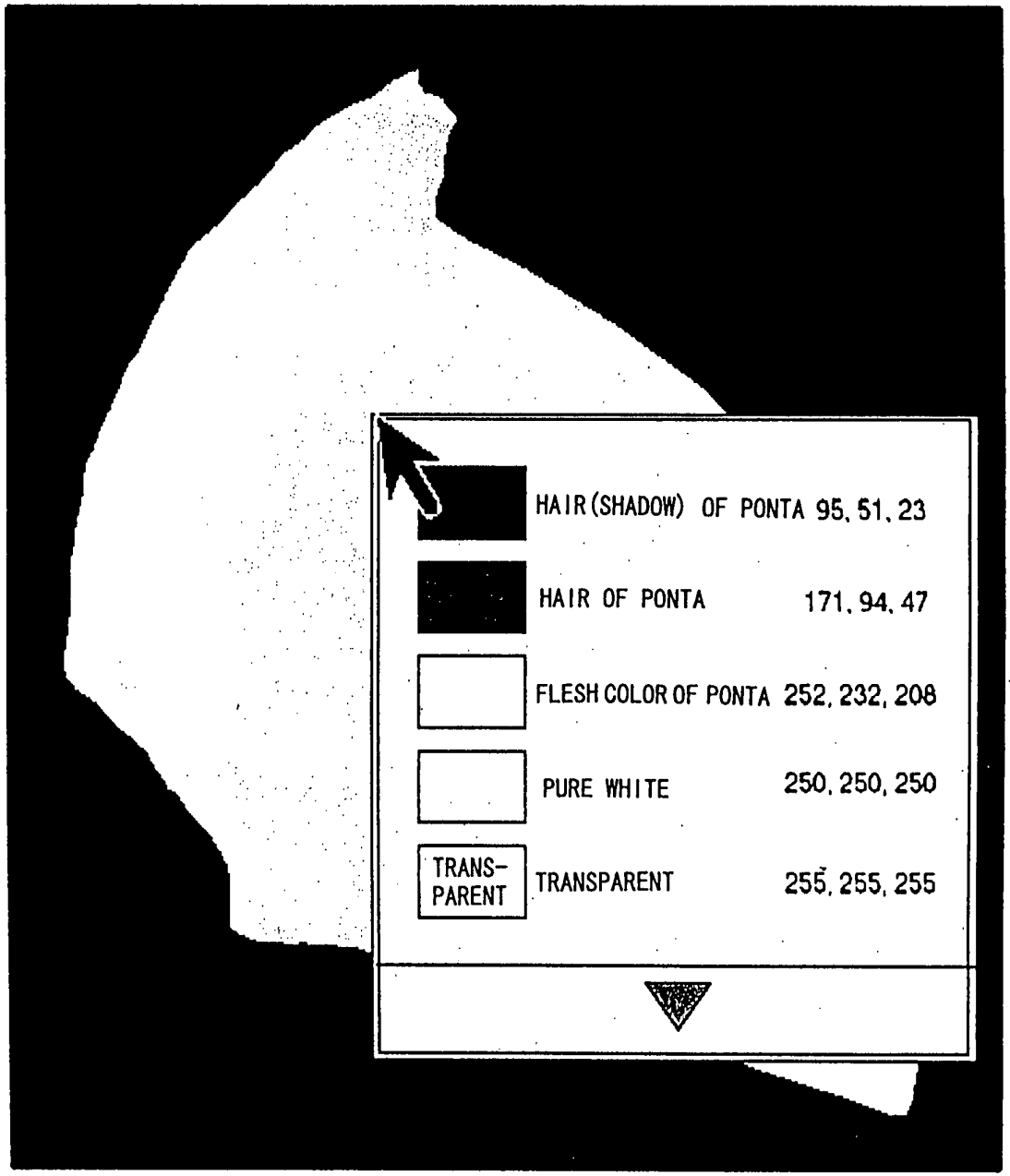

HAIR(SHADOW) OF PONTA 95, 51, 23
HAIR OF PONTA 171, 94, 47
FLESH COLOR OF PONTA 252, 232, 208
PURE WHITE 250, 250, 250
TRANS-PARENT
TRANSPARENT 255, 255, 255

FIG. 44

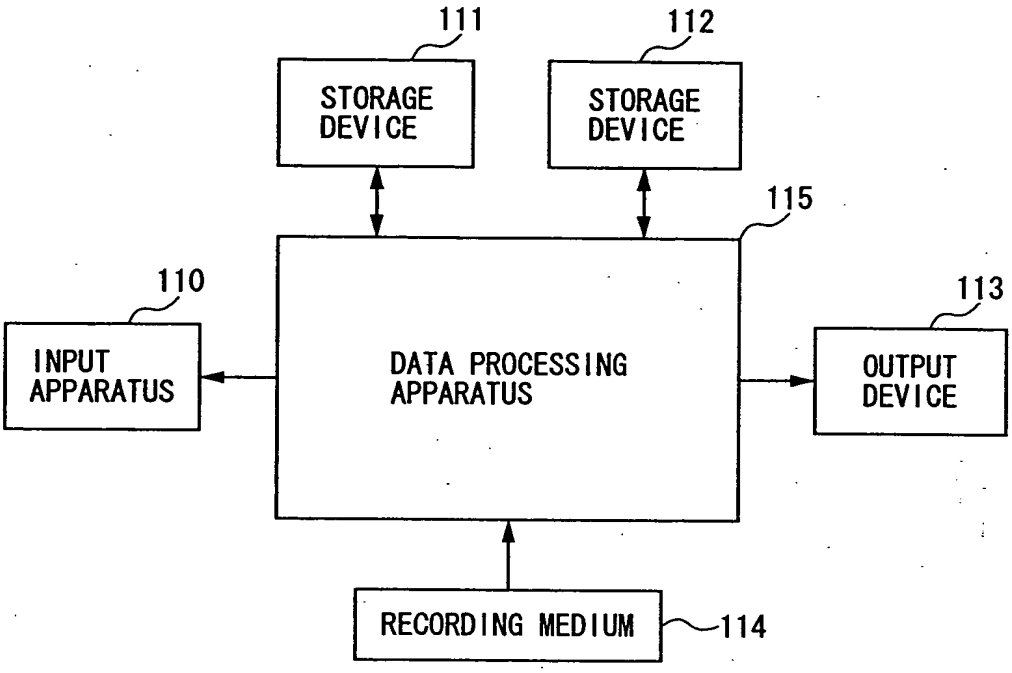

111
112
STORAGE DEVICE
STORAGE DEVICE
115
110
113
INPUT APPARATUS
DATA PROCESSING APPARATUS
OUTPUT DEVICE
RECORDING MEDIUM
114

FIG. 45

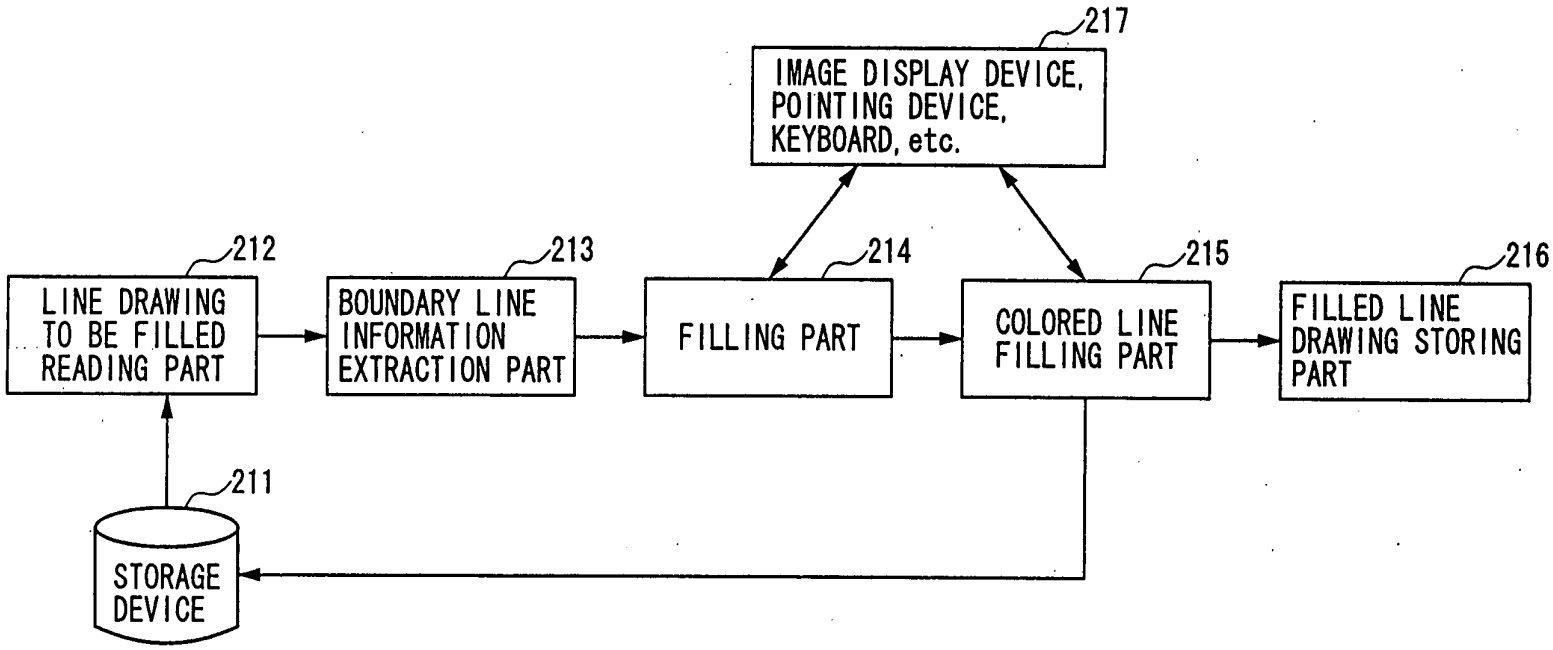

217
IMAGE DISPLAY DEVICE, POINTING DEVICE, KEYBOARD, etc.
212
LINE DRAWING TO BE FILLED READING PART
213
BOUNDARY LINE INFORMATION EXTRACTION PART
214
FILLING PART
215
COLORED LINE FILLING PART
216
FILLED LINE DRAWING STORING PART
211
STORAGE DEVICE

FIG. 46

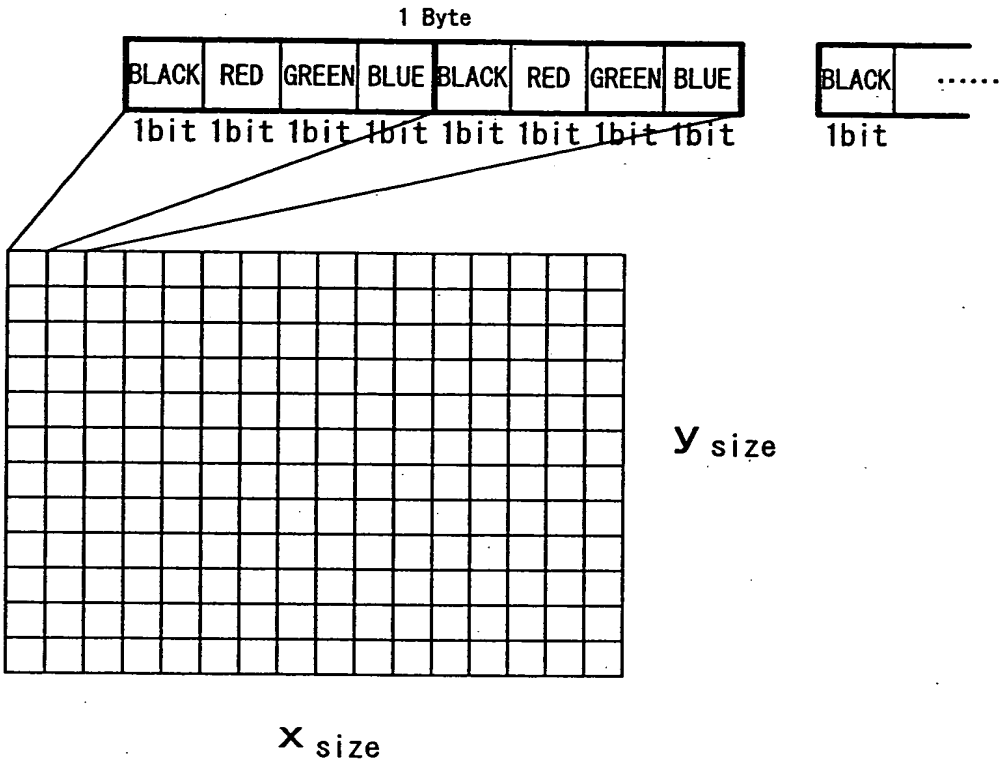

1 Byte
BLACK
RED
GREEN
BLUE
BLACK
RED
GREEN
BLUE
BLACK
.....
1bit 1bit 1bit 1bit 1bit 1bit 1bit 1bit
1bit
y size
x size

FIG. 47

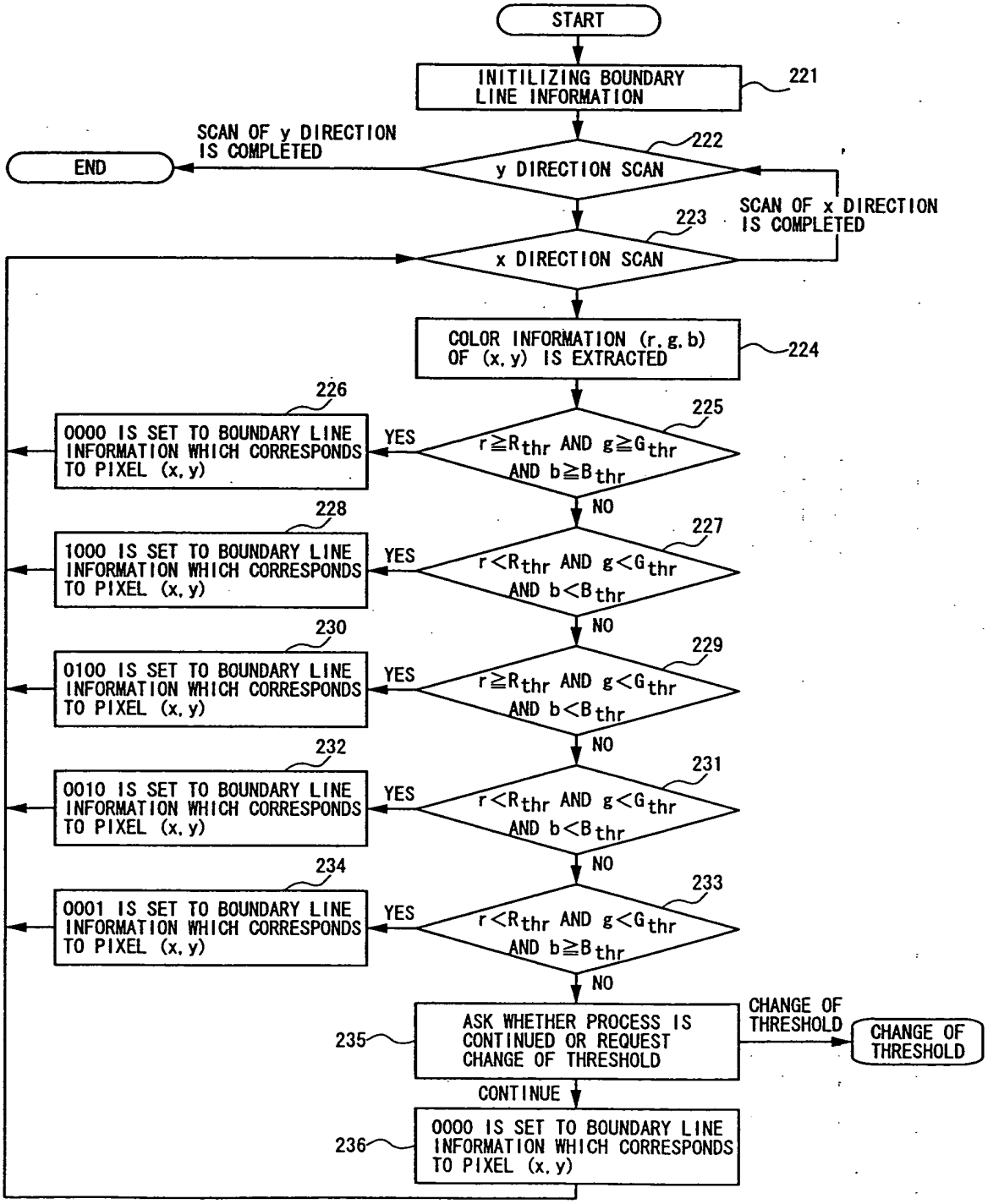

START
INITILIZING BOUNDARY LINE INFORMATION
221
y DIRECTION SCAN
222
SCAN OF y DIRECTION IS COMPLETED
END
SCAN OF x DIRECTION IS COMPLETED
x DIRECTION SCAN
223
COLOR INFORMATION (r, g, b) OF (x, y) IS EXTRACTED
224
r≧Rthr AND g≧Gthr AND b≧Bthr
225
YES
0000 IS SET TO BOUNDARY LINE INFORMATION WHICH CORRESPONDS TO PIXEL (x, y)
226
NO
r<Rthr AND g<Gthr AND b<Bthr
227
YES
1000 IS SET TO BOUNDARY LINE INFORMATION WHICH CORRESPONDS TO PIXEL (x, y)
228
NO
r≧Rthr AND g<Gthr AND b<Bthr
229
YES
0100 IS SET TO BOUNDARY LINE INFORMATION WHICH CORRESPONDS TO PIXEL (x, y)
230
NO
r<Rthr AND g<Gthr AND b<Bthr
231
YES
0010 IS SET TO BOUNDARY LINE INFORMATION WHICH CORRESPONDS TO PIXEL (x, y)
232
NO
r<Rthr AND g<Gthr AND b≧Bthr
233
YES
0001 IS SET TO BOUNDARY LINE INFORMATION WHICH CORRESPONDS TO PIXEL (x, y)
234
NO
ASK WHETHER PROCESS IS CONTINUED OR REQUEST CHANGE OF THRESHOLD
235
CHANGE OF THRESHOLD
CHANGE OF THRESHOLD
CONTINUE
0000 IS SET TO BOUNDARY LINE INFORMATION WHICH CORRESPONDS TO PIXEL (x, y)
236

FIG. 48

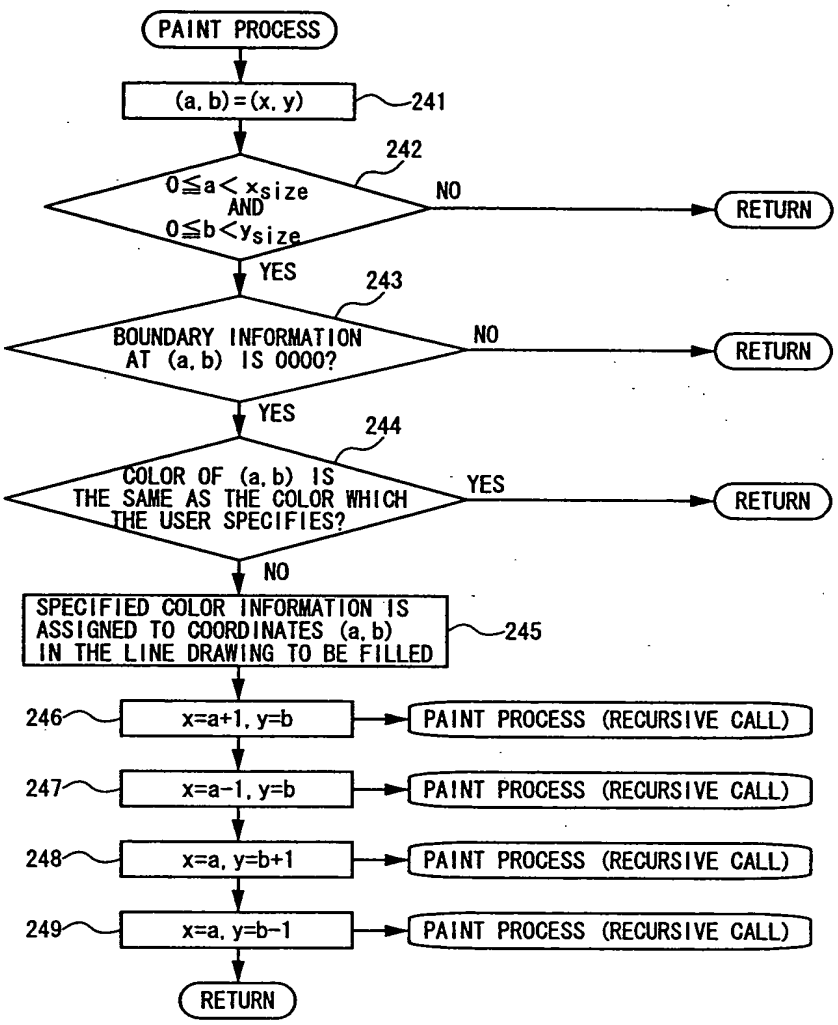

PAINT PROCESS
(a, b)=(x, y)
241
242
0≦a<xsize AND 0≦b<ysize
NO
RETURN
YES
243
BOUNDARY INFORMATION AT (a, b) IS 0000?
NO
RETURN
YES
244
COLOR OF (a, b) IS THE SAME AS THE COLOR WHICH THE USER SPECIFIES?
YES
RETURN
NO
SPECIFIED COLOR INFORMATION IS ASSIGNED TO COORDINATES (a, b) IN THE LINE DRAWING TO BE FILLED
245
246
x=a+1, y=b
PAINT PROCESS (RECURSIVE CALL)
247
x=a-1, y=b
PAINT PROCESS (RECURSIVE CALL)
248
x=a, y=b+1
PAINT PROCESS (RECURSIVE CALL)
249
x=a, y=b-1
PAINT PROCESS (RECURSIVE CALL)
RETURN

FIG. 49A

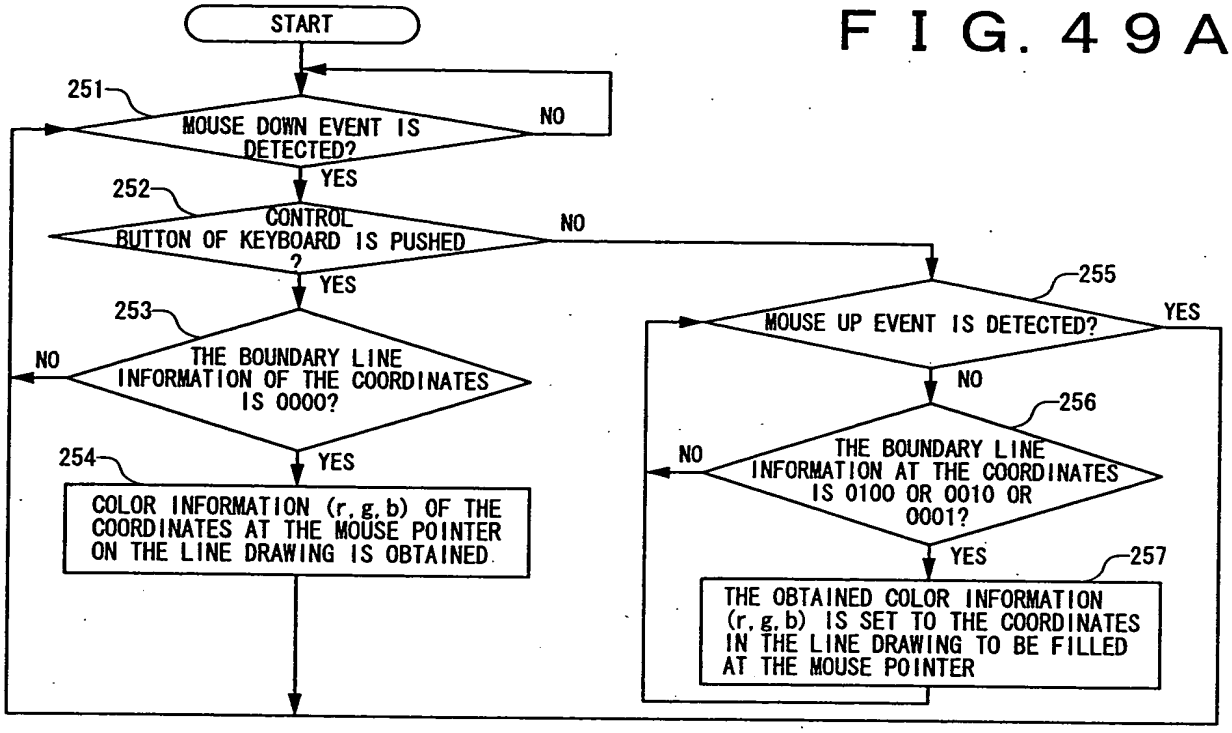


FIG. 49B

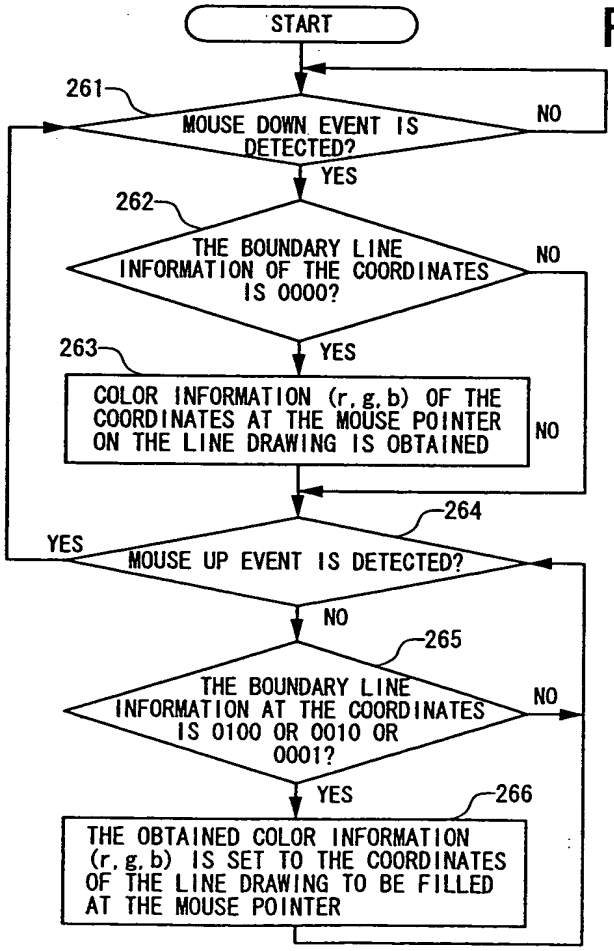
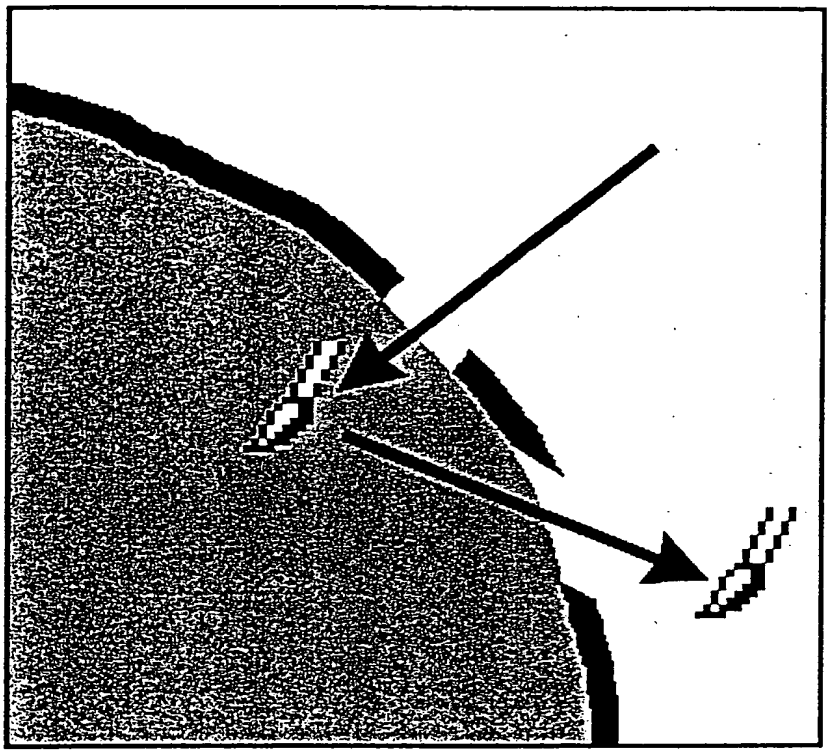


FIG.50



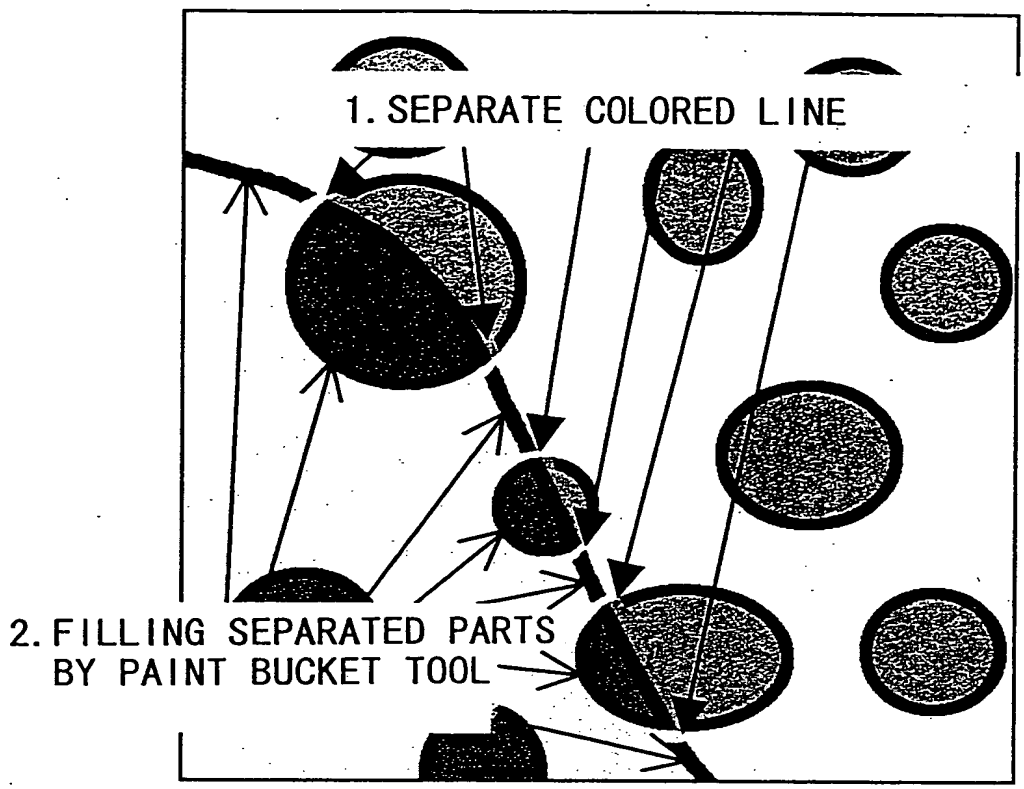


FIG.51A

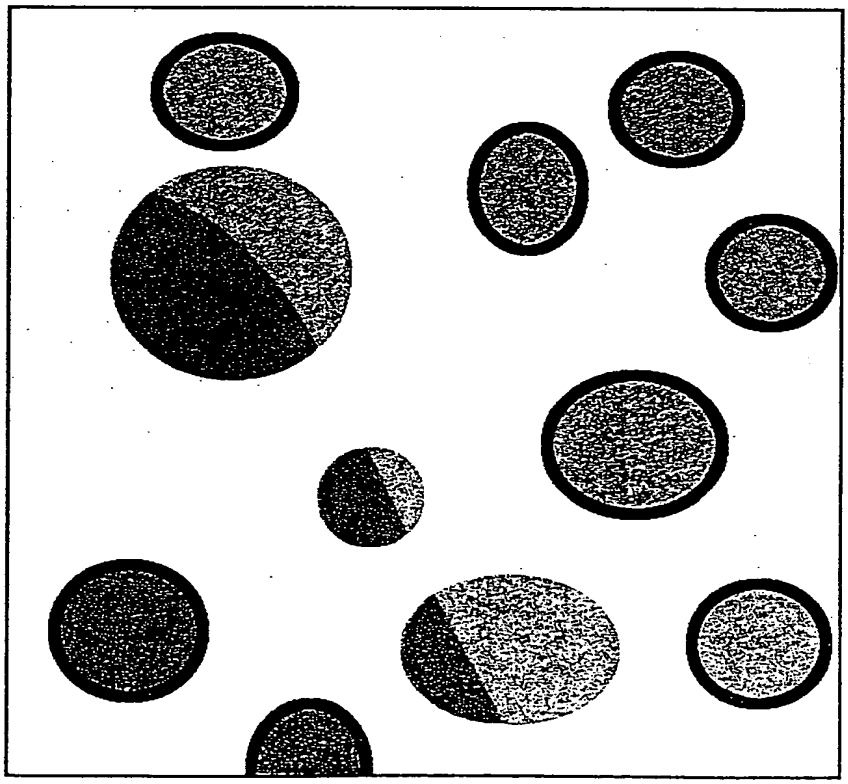


FIG.51B

FIG. 52

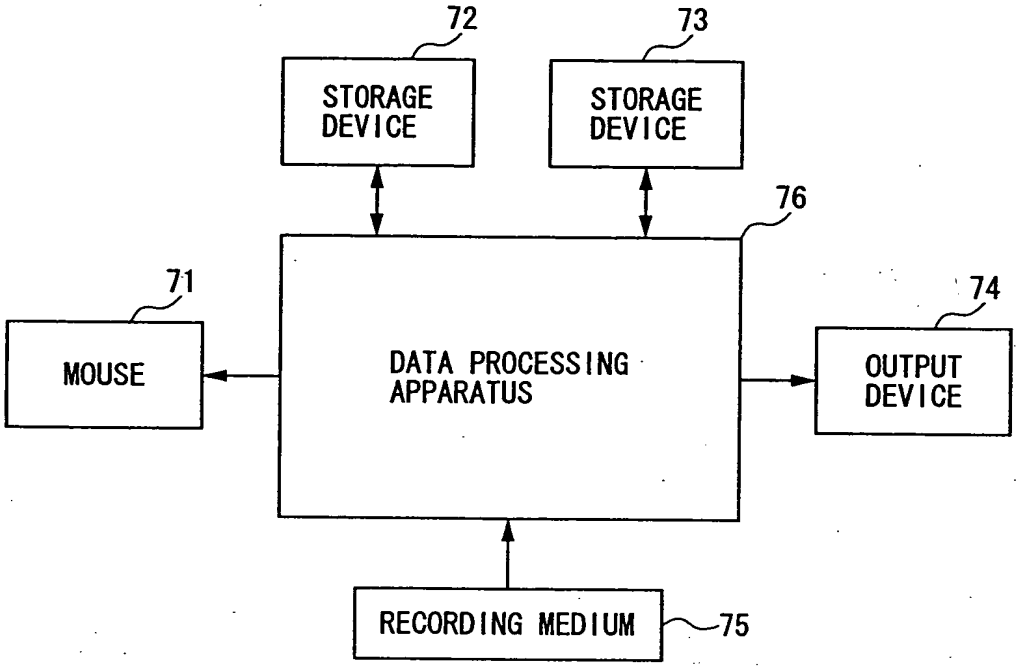

72
73
STORAGE DEVICE
STORAGE DEVICE
76
71
74
MOUSE
DATA PROCESSING APPARATUS
OUTPUT DEVICE
RECORDING MEDIUM
75

FIG. 53

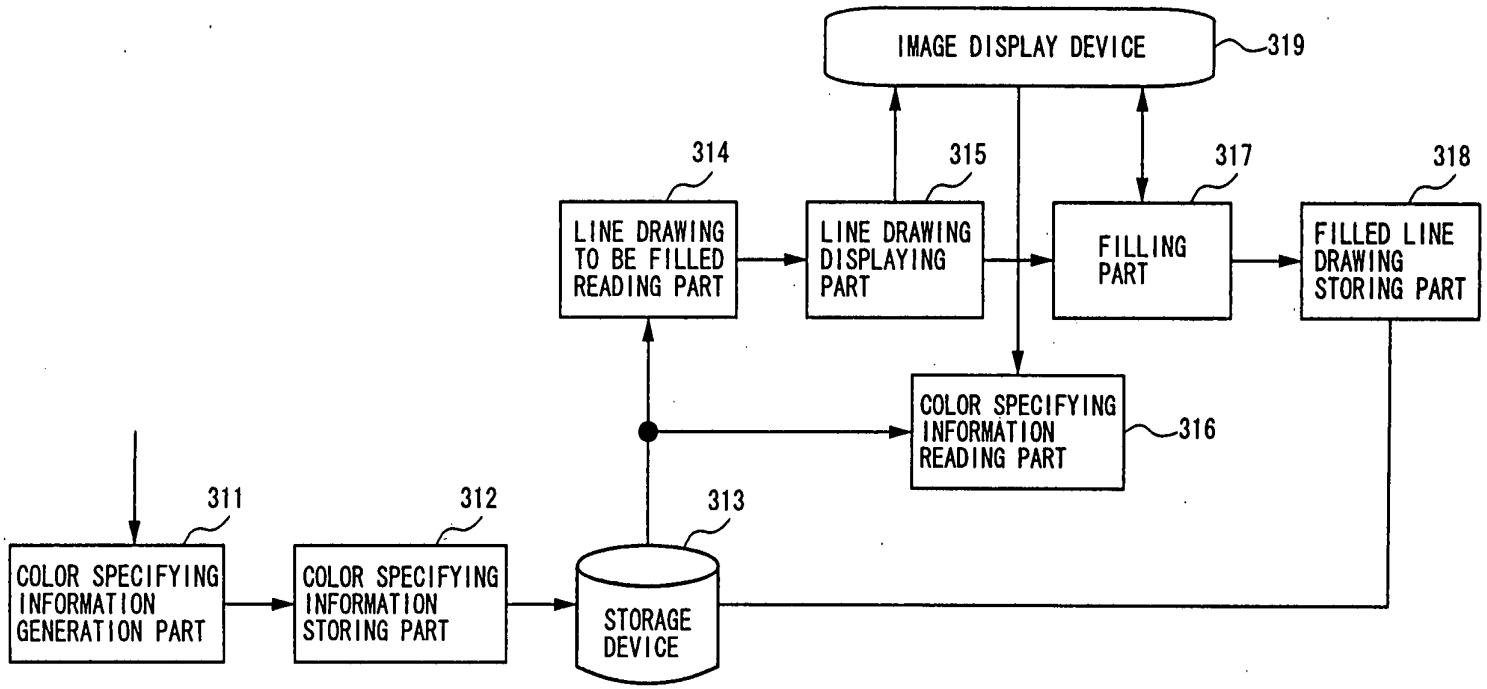


IMAGE DISPLAY DEVICE
319
314
315
317
318
LINE DRAWING TO BE FILLED READING PART
LINE DRAWING DISPLAYING PART
FILLING PART
FILLED LINE DRAWING STORING PART
COLOR SPECIFYING INFORMATION READING PART
316
311
312
313
COLOR SPECIFYING INFORMATION GENERATION PART
COLOR SPECIFYING INFORMATION STORING PART
STORAGE DEVICE

FIG. 54

COLOR (R, G, B)	COLOR ALIAS
117, 44, 5	HAIR COLOR 1
87, 14, 10	HAIR COLOR 2
222, 116, 61	HAIR HIGHLIGHT 1
173, 62, 4	HAIR HIGHLIGHT 2
53, 10, 7	HAIR FIRST SHADOW COLOR
23, 2, 1	HAIR SECOND SHADOW COLOR
234, 197, 126	FLESH COLOR
156, 116, 39	FLESH SHADOW COLOR
73, 142, 112	SHIRT COLOR 1
⋮	⋮

FIG. 55

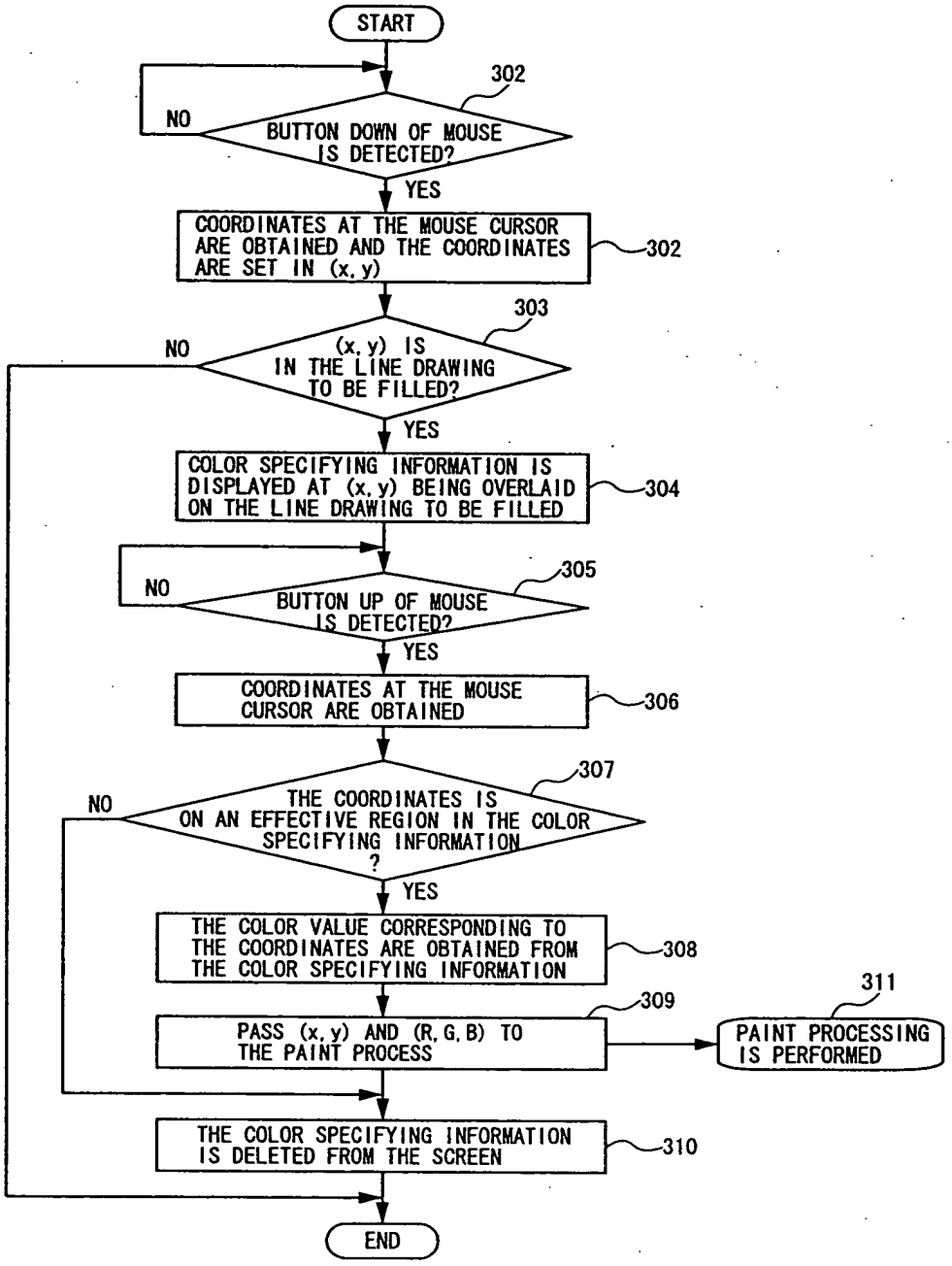

START
302
NO
BUTTON DOWN OF MOUSE IS DETECTED?
YES
COORDINATES AT THE MOUSE CURSOR ARE OBTAINED AND THE COORDINATES ARE SET IN (x, y)
302
303
NO
(x, y) IS IN THE LINE DRAWING TO BE FILLED?
YES
COLOR SPECIFYING INFORMATION IS DISPLAYED AT (x, y) BEING OVERLAID ON THE LINE DRAWING TO BE FILLED
304
305
NO
BUTTON UP OF MOUSE IS DETECTED?
YES
COORDINATES AT THE MOUSE CURSOR ARE OBTAINED
306
307
NO
THE COORDINATES IS ON AN EFFECTIVE REGION IN THE COLOR SPECIFYING INFORMATION ?
YES
THE COLOR VALUE CORRESPONDING TO THE COORDINATES ARE OBTAINED FROM THE COLOR SPECIFYING INFORMATION
308
309
PASS (x, y) AND (R, G, B) TO THE PAINT PROCESS
311
PAINT PROCESSING IS PERFORMED
THE COLOR SPECIFYING INFORMATION IS DELETED FROM THE SCREEN
310
END

FIG. 56

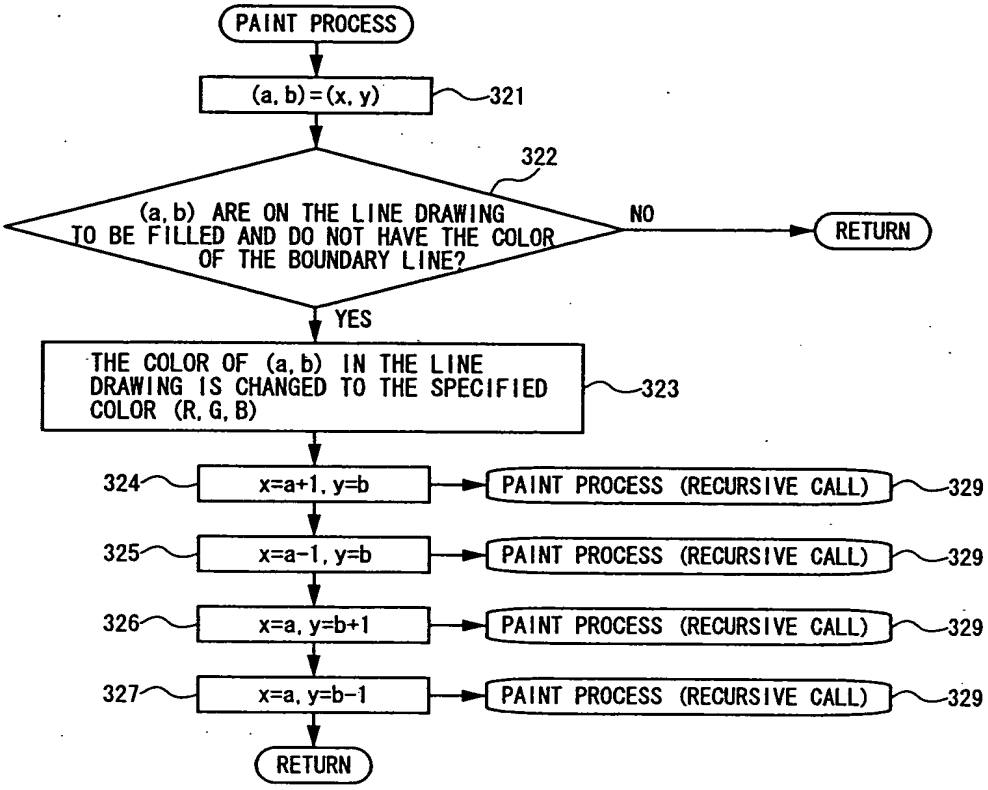

PAINT PROCESS
(a, b)=(x, y)
321
322
(a, b) ARE ON THE LINE DRAWING TO BE FILLED AND DO NOT HAVE THE COLOR OF THE BOUNDARY LINE?
NO
RETURN
YES
THE COLOR OF (a, b) IN THE LINE DRAWING IS CHANGED TO THE SPECIFIED COLOR (R, G, B)
323
324
x=a+1, y=b
PAINT PROCESS (RECURSIVE CALL)
329
325
x=a-1, y=b
PAINT PROCESS (RECURSIVE CALL)
329
326
x=a, y=b+1
PAINT PROCESS (RECURSIVE CALL)
329
327
x=a, y=b-1
PAINT PROCESS (RECURSIVE CALL)
329
RETURN

FIG.57A

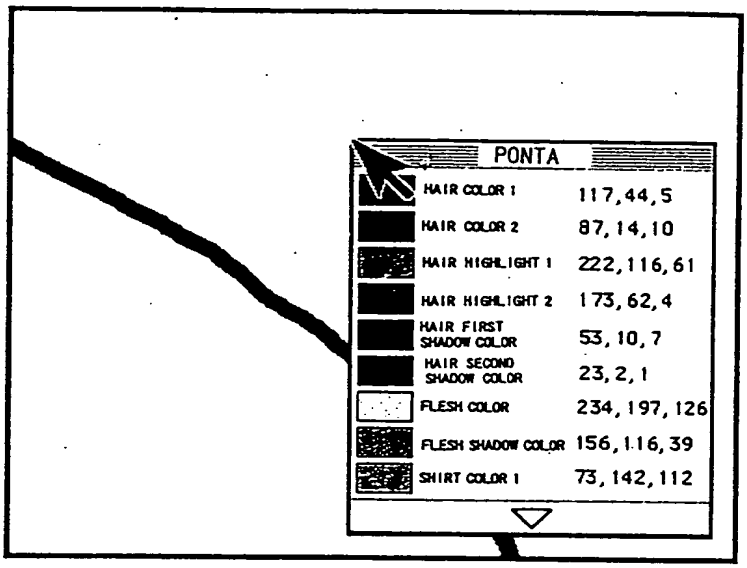
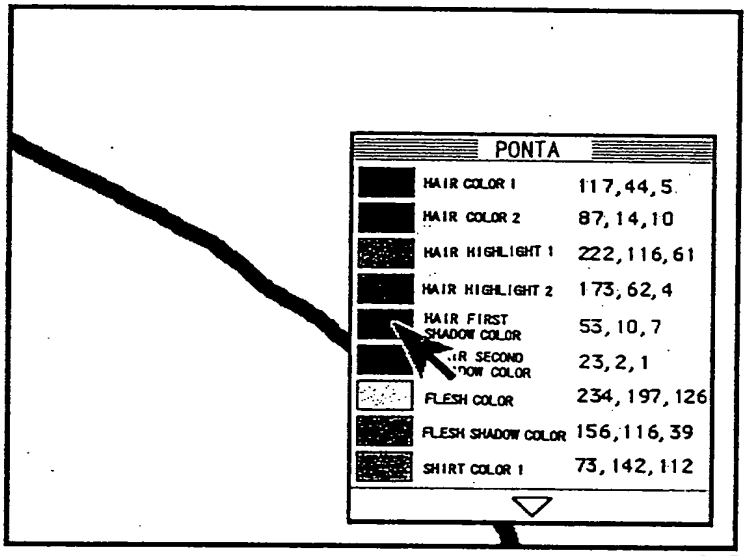


FIG.57B



HAIR FIRST SHADOW COLOR

FIG.57C

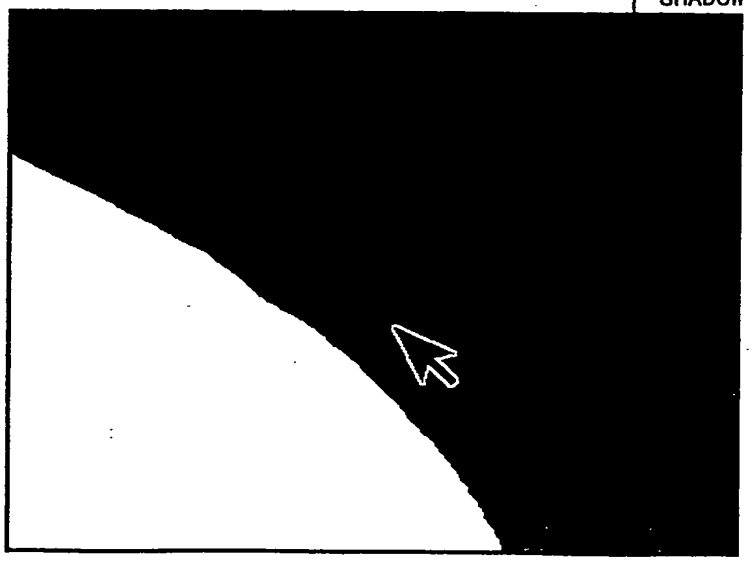


FIG. 58

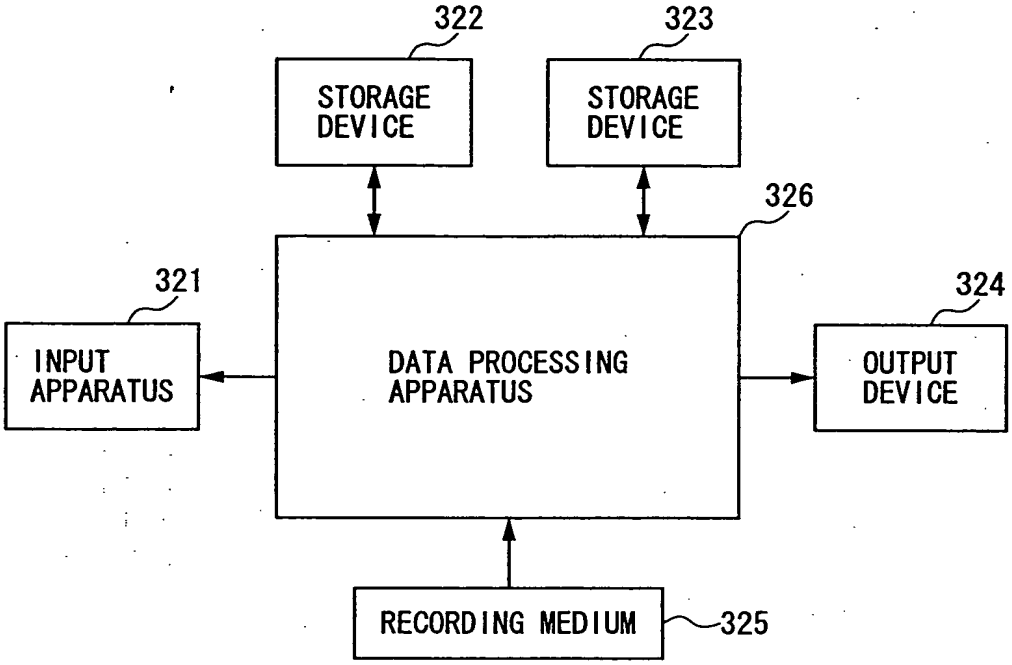

322
323
STORAGE DEVICE
STORAGE DEVICE
326
321
324
INPUT APPARATUS
DATA PROCESSING APPARATUS
OUTPUT DEVICE
RECORDING MEDIUM
325

FIG. 59

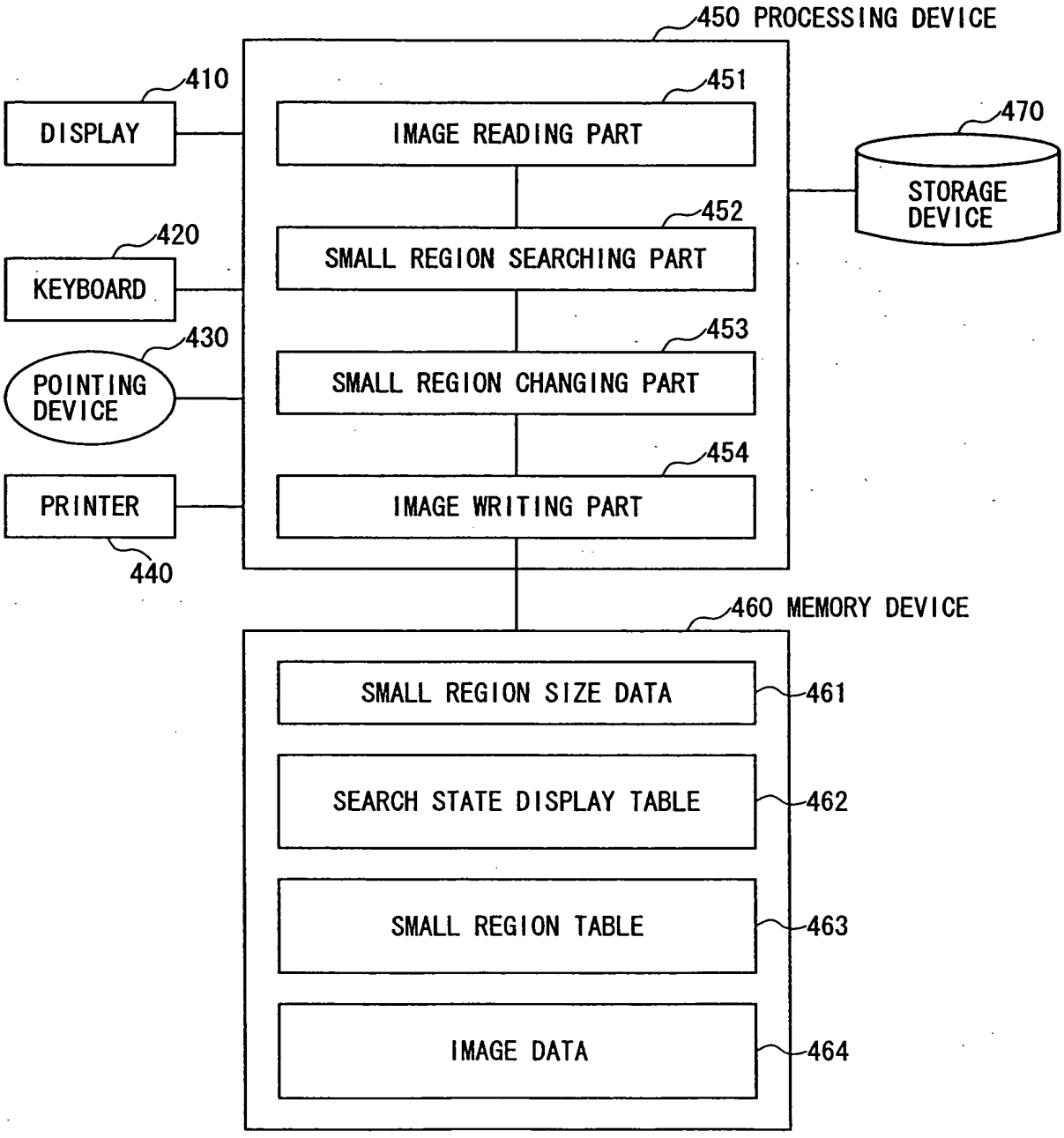

450 PROCESSING DEVICE
410
DISPLAY
451
IMAGE READING PART
470
STORAGE DEVICE
452
SMALL REGION SEARCHING PART
420
KEYBOARD
430
POINTING DEVICE
453
SMALL REGION CHANGING PART
454
PRINTER
IMAGE WRITING PART
440
460 MEMORY DEVICE
SMALL REGION SIZE DATA
461
SEARCH STATE DISPLAY TABLE
462
SMALL REGION TABLE
463
IMAGE DATA
464

FIG. 60

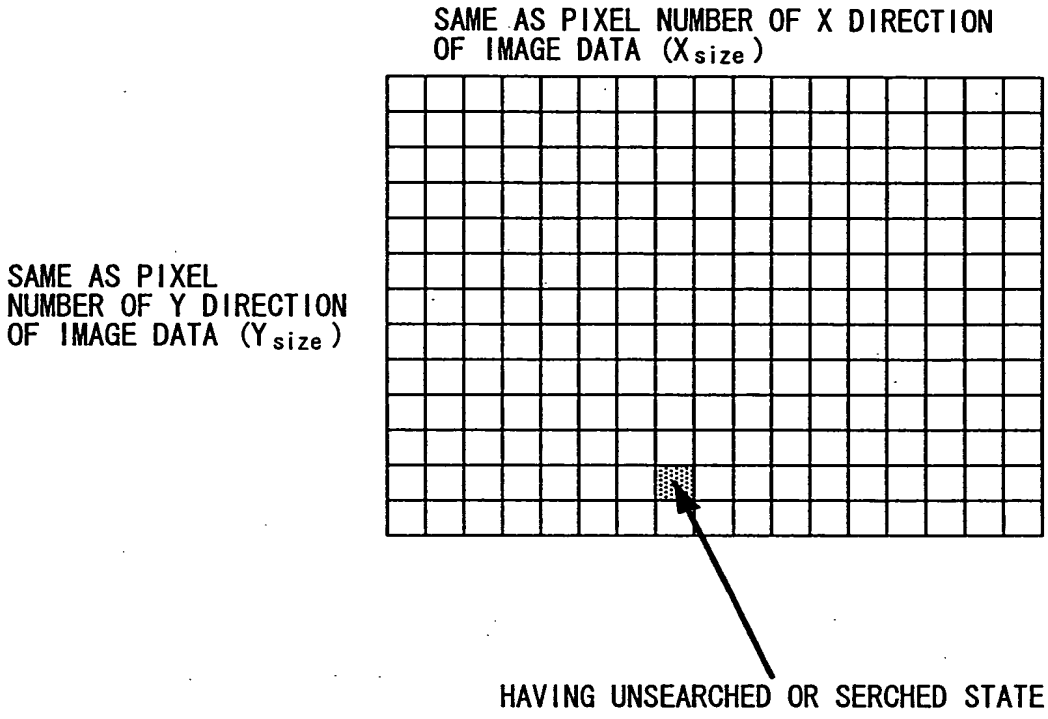

SAME AS PIXEL NUMBER OF X DIRECTION OF IMAGE DATA (X_{size})
SAME AS PIXEL NUMBER OF Y DIRECTION OF IMAGE DATA (Y_{size})
HAVING UNSEARCHED OR SERCHED STATE

FIG. 61

SMALL REGION NUMBER			COUNT
NUMBER	SIZE	COORDINATES	CHANGE STATE
0	num[0]	x[0], y[0]	0
1	num[1]	x[1], y[1]	0
2	num[2]	x[2], y[2]	0
3	num[3]	x[3], y[3]	0
4	num[4]	x[4], y[4]	0
5	num[5]	x[5], y[5]	0
6	num[6]	x[6], y[6]	0
7	num[7]	x[7], y[7]	0
8	num[8]	x[8], y[8]	0
⋮	⋮	⋮	⋮

FIG. 62

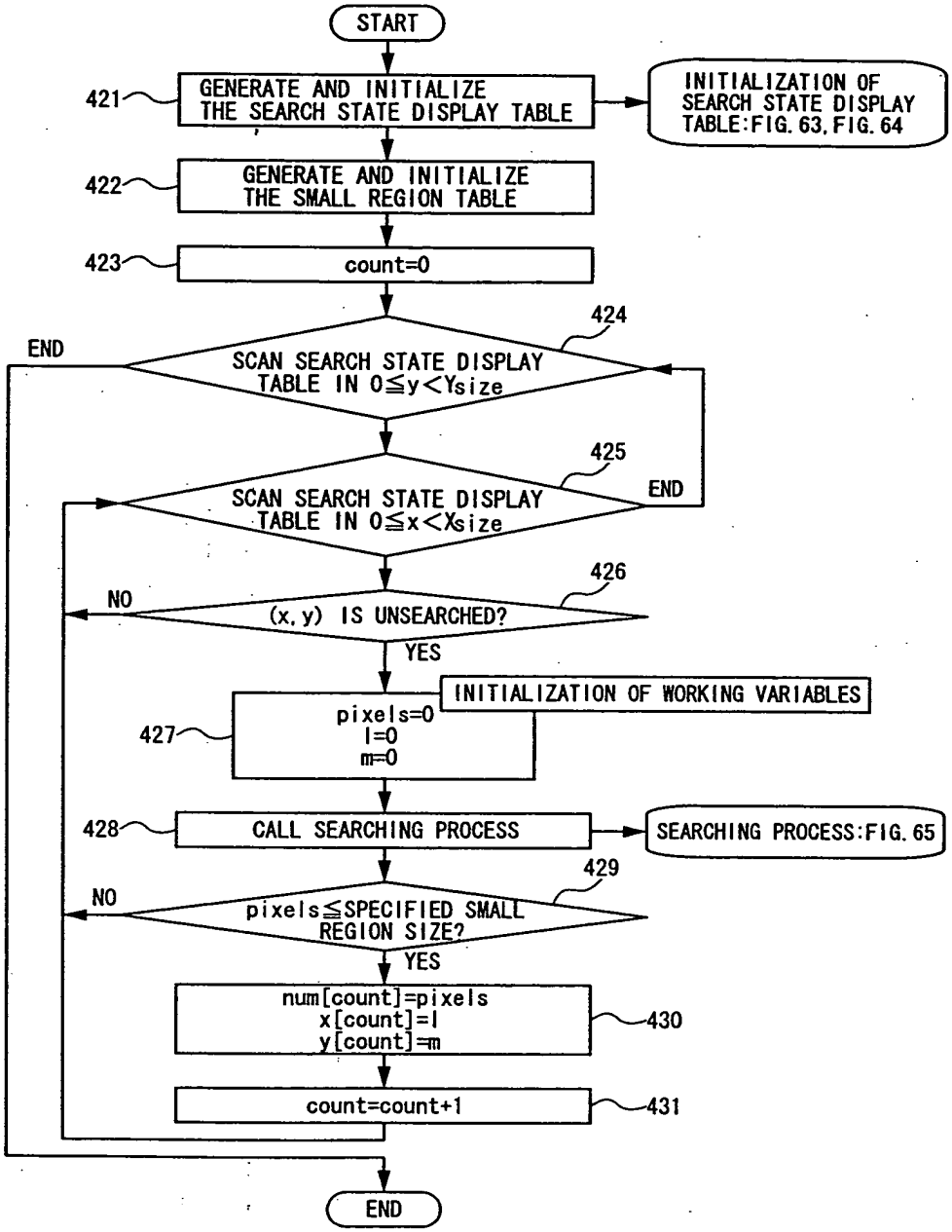

START
421
GENERATE AND INITIALIZE THE SEARCH STATE DISPLAY TABLE
INITIALIZATION OF SEARCH STATE DISPLAY TABLE:FIG. 63, FIG. 64
422
GENERATE AND INITIALIZE THE SMALL REGION TABLE
423
count=0
424
SCAN SEARCH STATE DISPLAY TABLE IN 0≦y<Ysize
END
425
SCAN SEARCH STATE DISPLAY TABLE IN 0≦x<Xsize
END
426
(x, y) IS UNSEARCHED?
NO
YES
INITIALIZATION OF WORKING VARIABLES
427
pixels=0
l=0
m=0
428
CALL SEARCHING PROCESS
SEARCHING PROCESS:FIG. 65
429
pixels≦SPECIFIED SMALL REGION SIZE?
NO
YES
num[count]=pixels
x[count]=l
y[count]=m
430
count=count+1
431
END

FIG. 63

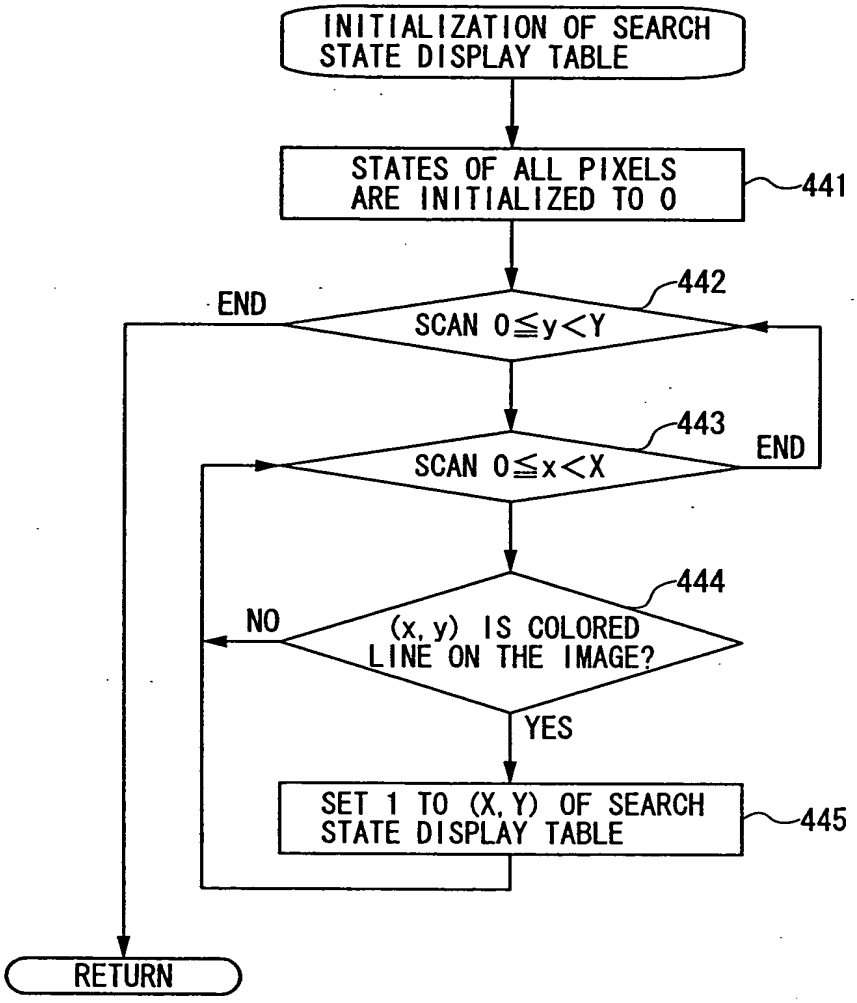

INITIALIZATION OF SEARCH STATE DISPLAY TABLE
STATES OF ALL PIXELS ARE INITIALIZED TO 0
441
442
END
SCAN 0≦y<Y
443
SCAN 0≦x<X
END
444
NO
(x, y) IS COLORED LINE ON THE IMAGE?
YES
SET 1 TO (X, Y) OF SEARCH STATE DISPLAY TABLE
445
RETURN

FIG. 64

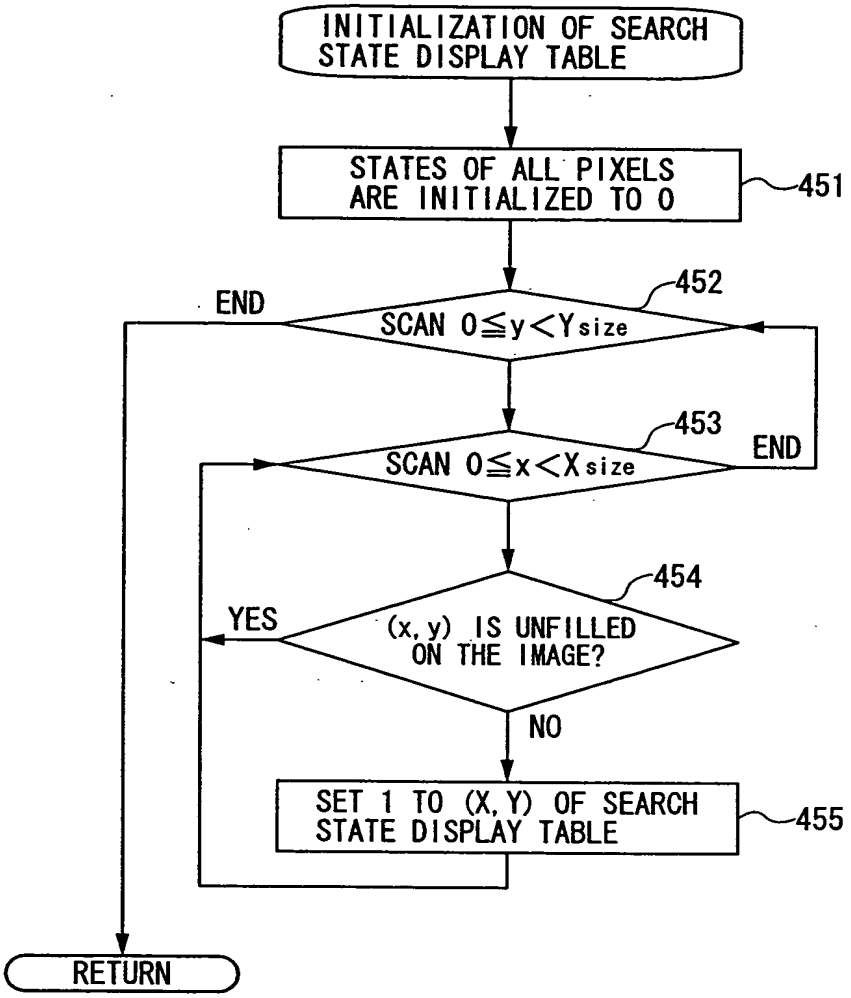

INITIALIZATION OF SEARCH STATE DISPLAY TABLE
STATES OF ALL PIXELS ARE INITIALIZED TO 0
451
452
END
SCAN 0≦y<Ysize
453
SCAN 0≦x<Xsize
END
454
YES
(x, y) IS UNFILLED ON THE IMAGE?
NO
SET 1 TO (X, Y) OF SEARCH STATE DISPLAY TABLE
455
RETURN

FIG. 65

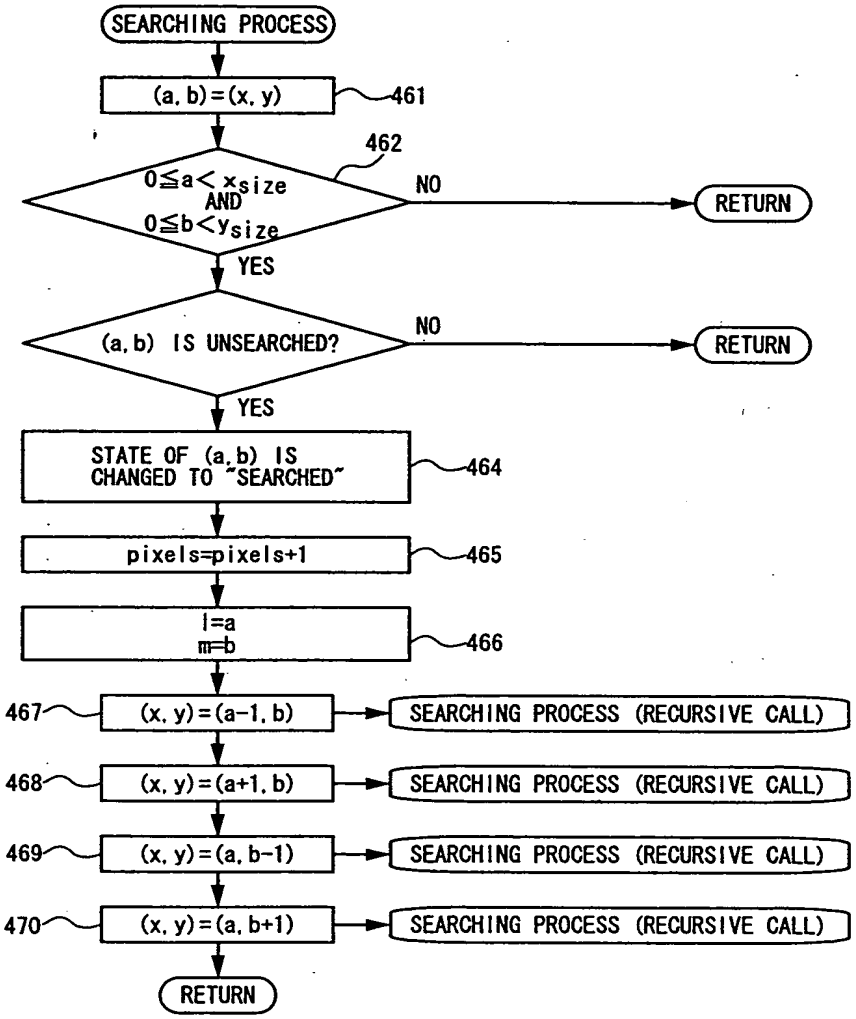

SEARCHING PROCESS
(a, b)=(x, y)
461
462
0≦a<xsize AND 0≦b<ysize
NO
RETURN
YES
(a, b) IS UNSEARCHED?
NO
RETURN
YES
STATE OF (a, b) IS CHANGED TO "SEARCHED"
464
pixels=pixels+1
465
l=a
m=b
466
467
(x, y)=(a-1, b)
SEARCHING PROCESS (RECURSIVE CALL)
468
(x, y)=(a+1, b)
SEARCHING PROCESS (RECURSIVE CALL)
469
(x, y)=(a, b-1)
SEARCHING PROCESS (RECURSIVE CALL)
470
(x, y)=(a, b+1)
SEARCHING PROCESS (RECURSIVE CALL)
RETURN

FIG. 66

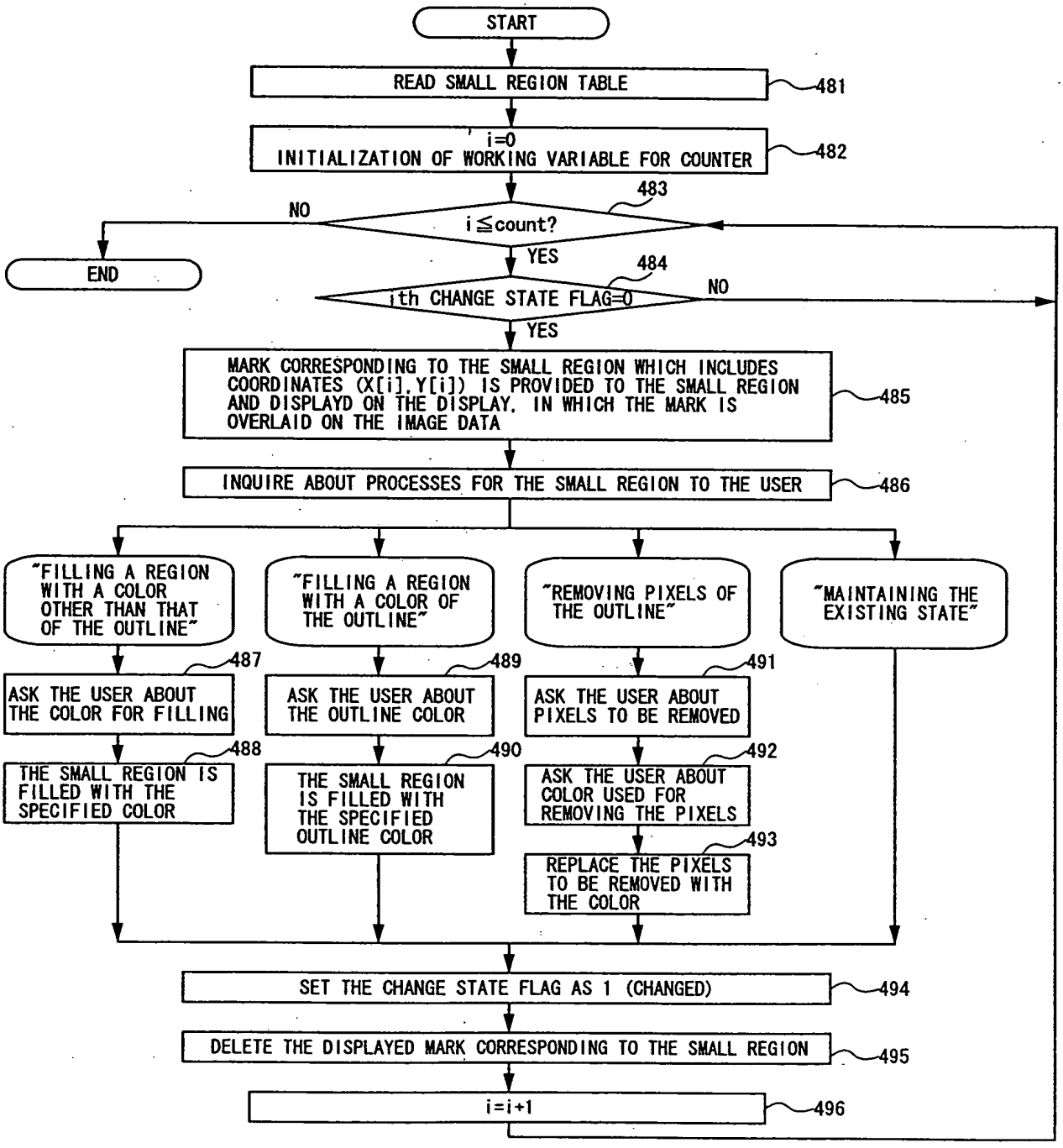

START
READ SMALL REGION TABLE
481
i=0
INITIALIZATION OF WORKING VARIABLE FOR COUNTER
482
483
NO
i≦count?
YES
END
484
ith CHANGE STATE FLAG=0
NO
YES
MARK CORRESPONDING TO THE SMALL REGION WHICH INCLUDES COORDINATES (X[i], Y[i]) IS PROVIDED TO THE SMALL REGION AND DISPLAYD ON THE DISPLAY, IN WHICH THE MARK IS OVERLAID ON THE IMAGE DATA
485
INQUIRE ABOUT PROCESSES FOR THE SMALL REGION TO THE USER
486
"FILLING A REGION WITH A COLOR OTHER THAN THAT OF THE OUTLINE"
"FILLING A REGION WITH A COLOR OF THE OUTLINE"
"REMOVING PIXELS OF THE OUTLINE"
"MAINTAINING THE EXISTING STATE"
487
ASK THE USER ABOUT THE COLOR FOR FILLING
489
ASK THE USER ABOUT THE OUTLINE COLOR
491
ASK THE USER ABOUT PIXELS TO BE REMOVED
488
THE SMALL REGION IS FILLED WITH THE SPECIFIED COLOR
490
THE SMALL REGION IS FILLED WITH THE SPECIFIED OUTLINE COLOR
492
ASK THE USER ABOUT COLOR USED FOR REMOVING THE PIXELS
493
REPLACE THE PIXELS TO BE REMOVED WITH THE COLOR
SET THE CHANGE STATE FLAG AS 1 (CHANGED)
494
DELETE THE DISPLAYED MARK CORRESPONDING TO THE SMALL REGION
495
i=i+1
496

FIG.67A

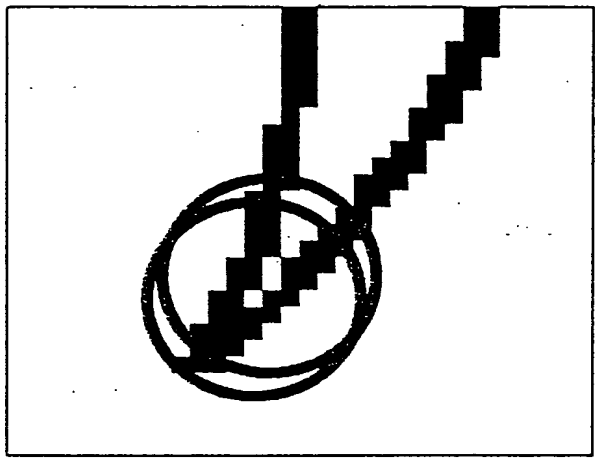


FIG.67B

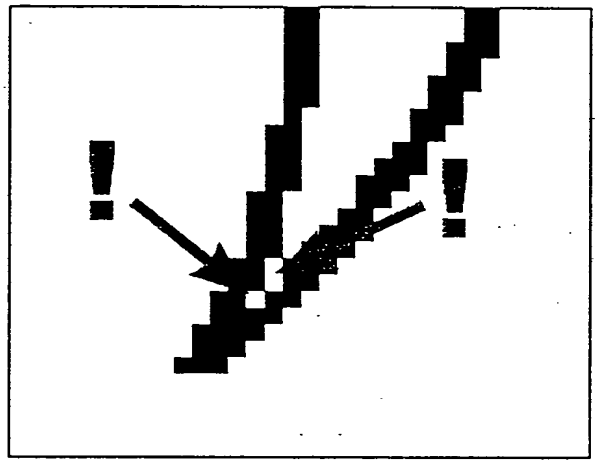
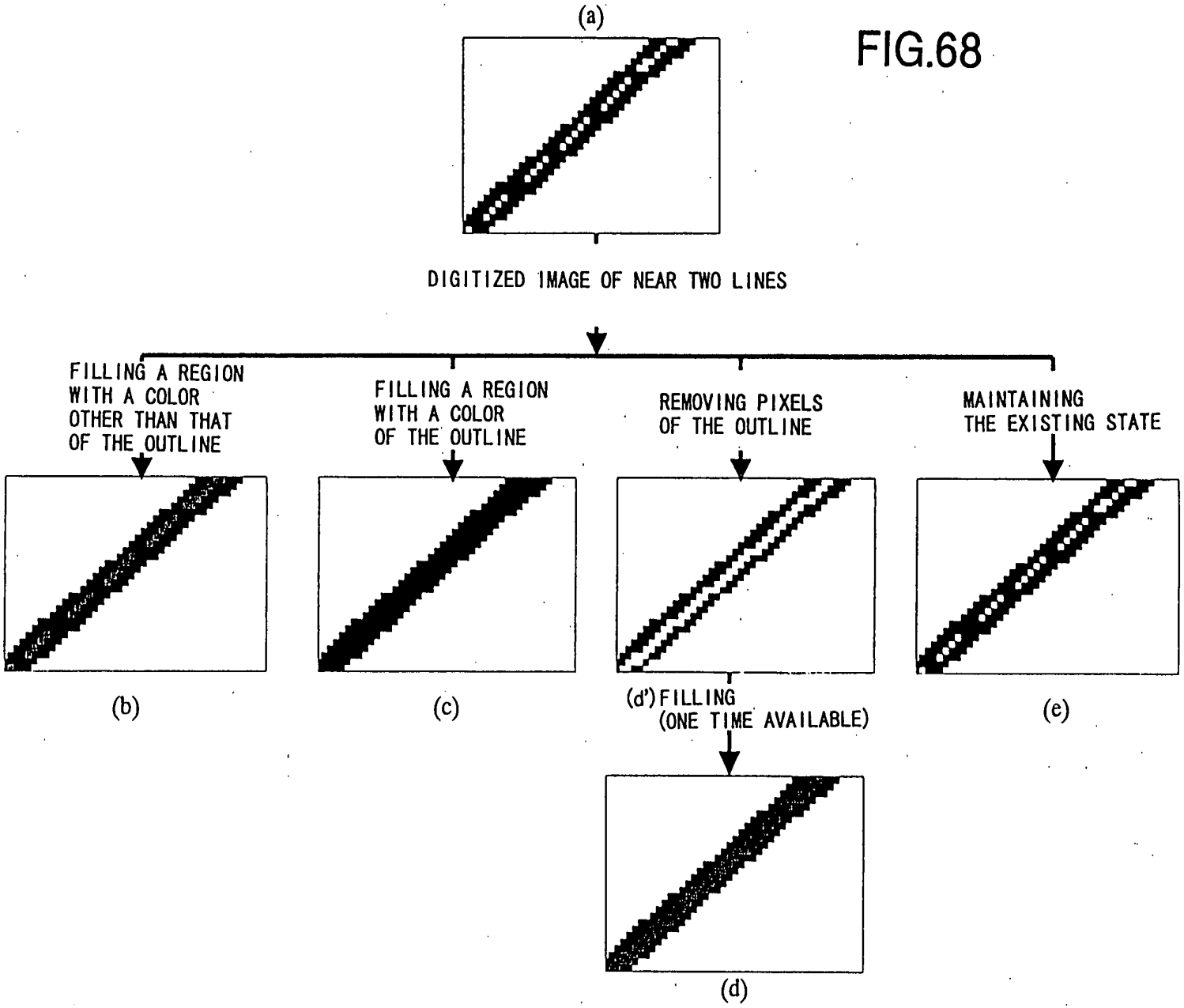


FIG.68


(a)
DIGITIZED IMAGE OF NEAR TWO LINES
FILLING A REGION WITH A COLOR OTHER THAN THAT OF THE OUTLINE
FILLING A REGION WITH A COLOR OF THE OUTLINE
REMOVING PIXELS OF THE OUTLINE
MAINTAINING THE EXISTING STATE
(b)
(c)
(d') FILLING (ONE TIME AVAILABLE)
(e)
(d)